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Development Document for Effluent Limitations Guidelines, New Source Performance Standards and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category. Volume II

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Final

Iron and Steel Manufacturing

Point Source Category

Volume II

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Sintering Subcategory
Iron Making Subcategory

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Volume II of six volume set which presents data rationale and technical aspects of the final effluent limitations and standards for the iron and steel industry published in the Federal Register on May 27, 1982 (47 FR 23258-317). Volume II describes the general methodology and issues whereas the remaining volumes contain specific subcategory reports. Volume II pertains to the Coke Making, Sintering and Iron Making subcategories.

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COKEMAKING SUBCATEGORY

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COKEMAKING SUBCATEGORY

SECTION I

PREFACE

The USEPA has promulgated effluent limitations and standards for the steel industry pursuant to Sections 301, 304, 306, 307 and 501 of the Clean Water Act. The regulation contains effluent limitations for best practicable control technology currently available (BPT), best conventional pollutant control technology (BCT), and best available technology economically achievable (BAT) as well as pretreatment standards for new and existing sources (PSNS and PSES) and new source performance standards (NSPS).

This part of the Development Document highlights the technical aspects of EPA's study of the Cokemaking Subcategory of the Iron and Steel Industry. Volume I of the Development Document addresses general issues pertaining to the industry, while other volumes contain specific subcategory reports.

COKEMAKING SUBCATEGORY

SECTION II

CONCLUSIONS

Based upon this study, a review of previous studies by EPA, and, comments received on the proposed regulation (46 FR 1858), the Agency has reached the following conclusions:

1. The Agency is retaining the previous subcategorization of the cokemaking subcategory into by-product and beehive cokemaking operations based upon the differences in the respective manufacturing processes. The Agency has also retained the segmentation of the by-product cokemaking subdivision into biological and physical/chemical treatment methods at the BAT level. Based upon slightly higher flow rates found at merchant coke plants, a separate subdivision for merchant coke plants has been developed.

2. For the most part, the originally promulgated BPT limitations (1974) are practicable and achievable at all coke plants. In fact, data obtained by the Agency since that time shows that the previous limitations for by-product coke plants are more lenient than could be justified for all pollutants except total suspended solids. Nonetheless, except for total suspended solids, the promulgated BPT limitations are the same as those contained in the prior regulation. For beehive operations, the previously promulgated BPT limitation of zero discharge of pollutants has been retained.

3. Sampling and analysis of by-product coke plant wastewaters revealed high concentrations of more than 40 toxic pollutants. Cokemaking operations generate more toxic pollutants than any industrial category examined by EPA. The discharge of these toxic pollutants can, however, be significantly reduced by industry compliance with the BPT and BAT limitations and PSES as shown below:

Direct Dischargers
Effluent Loadings (Tons/Yr)

	Raw Waste	BPT	BAT
Flow, MGD	24	33	23
TSS	1830	3340	2280
Oil and Grease	2740	405	173
Ammonia-N	21940	3800	242
Total Cyanide	1830	253	86
Phenols (4AAP)	10970	25	1
Toxic Organics	4340	138	25
Toxic Metals	95	35	24
Other Pollutants	23040	152	24

Indirect Dischargers
Effluent Loadings (Tons/Yr)

	Raw Waste	PSES
Flow, MGD	7.4	4.8
TSS	563.3	723.9
Oil and Grease	844.9	108.6
Ammonia-N	6759.1	434.4
Total Cyanide	563.3	115.8
Phenols (4AAP)	3379.5	260.6
Toxic Organics	1336.0	208.1
Toxic Metals	29.3	10.8
Other Pollutants	7097.1	1664.9

4. The Agency's estimates of the investment and annual costs to achieve the BPT and BAT limitations for the Cokemaking subcategory are shown below. The Agency has determined that the effluent reduction benefits associated with compliance with the limitations and standards justify the costs.

Costs (millions of July 1, 1978 dollars)

	Investment Costs			Annual Costs
	Total	In-Place	Required	Total
BPT	168.6	120.9	47.7	41.6
BAT	44.1	11.1	33.0	11.5
PSES	45.8	30.9	14.9	10.2
TOTAL	258.5	162.9	95.6	63.3

- The Agency has also determined that the effluent reduction benefits associated with compliance with new source standards (NSPS, PSNS) justify those costs.

"Confidential" plant costs are not included. No additional capital investment for beehive operations is anticipated, since the remaining active plants achieve no discharge. Annual operating costs for beehive cokemaking wastewater treatment is less than $60,000 per year.

5. The Agency has promulgated BCT limitations for suspended solids and oil and grease that are the same as the respective BPT limitations. For beehive operations, both the BPT and BCT limitations are zero discharge.

6. With regard to the Third Circuit's "remand issues", the Agency concludes that:

    a. The estimated costs for the model wastewater treatment systems are sufficient to cover all costs required to install and operate the model technologies, whether as an initial fit or a retrofit. The Agency has also concluded that the ability to implement the model wastewater treatment systems is not affected by plant age or size. A comparison between the costs reported by the industry and the Agency's estimated costs for several plants demonstrates that the estimated model wastewater treatment costs are sufficient to account for all site-specific and other incidental costs which might be incurred.

    b. The Court ruled that the NSPS model flow of 100 gal/ton was "not demonstrated" and therefore, remanded that issue to the Agency for reconsideration. In addition to the four plants surveyed in the original study by the Agency, other plants have demonstrated process wastewater flows of 100 GPT or less, including two of the five participants in the toxic pollutant sampling phase of this study. In addition, process flows of less than 100 gal/ton were reported by the industry in response to questionnaires for 24% of all plants surveyed. However, the Agency increased the model flow used to establish the BAT limitations and NSPS to 153 gal/ton to account for additional wastewater flows generated by wet air pollution control systems and to allow for up to 50 gal/ton of dilution water for optimization of biological treatment systems.

    c. The 175 gal/ton model discharge flow used to develop the BPT limitations is demonstrated and, in fact, is less stringent than might otherwise be justified. The increased data base now available shows that 47% of the by-product coke plants discharge less than 175 gpt and the average flow for 80% of the plants is 173 gpt.

    d. The previously promulgated BPT limitations for ammonia-N are appropriate and the Agency has promulgated BPT limitations which are identical. The BPT limitations for ammonia-N are achieved at the sampled plants using free and fixed ammonia removal stills included in the BPT model treatment system, and at plants with biological treatment. The Agency believes the ammonia-N BPT limitations can be achieved at all coke plants with proper operation of both physical-chemical and biological treatment systems.

e. The components of the BAT model treatment systems are installed on a full scale basis at cokemaking operations and the BAT limitations are demonstrated at one plant in the industry. Multi-step biological treatment is practiced at Plant 0868A, and other treatment systems are designed to provide for such operation. Recycle of barometric condenser water, with less than 4% blowdown is practiced at Plants 0112D, 0448A and 0856F, and the blowdown flows at the latter two plants are 3 gallons per ton or less.

7. Although a significant number of toxic pollutants have been identified in the raw wastewaters from by-product cokemaking operations, the Agency does not believe it is necessary to limit each toxic pollutant detected. Adequate regulation of toxic pollutants is attained by establishing limitations for cyanide, phenols (4AAP), benzene, naphthalene, and benzo(a)pyrene. Phenols (4AAP) accurately represent acid extractable toxic organic pollutants. Benzene has been selected to indicate volatile organic pollutants, while naphthalene and benzo(a)pyrene indicate base/neutral extractable organic pollutants found in cokemaking wastewaters. By limiting the discharge of these pollutants, effective control is provided for all toxic pollutants found in untreated cokemaking wastewaters.

8. The Agency has promulgated separate BAT limitations for those existing sources which have full scale physical/chemical BAT treatment systems that include activated carbon adsorption systems.

9. Tables II-1 and II-2 present the BPT and BCT effluent limitations and the model flow rates and effluent quality for iron and steel and merchant cokemaking operations, respectively. Tables II-3 and II-4, present the BAT and NSPS limitations and standards for the iron and steel and merchant cokemaking operations, respectively. Table II-5 presents BAT limitations applicable to iron and steel and merchant cokemaking operations which use physical/ chemical treatment systems. Tables II-6 and II-7 present the respective PSES and PSNS.

TABLE II-1

BPT AND BCT MODEL FLOW, MODEL EFFLUENT QUALITY AND EFFLUENT LIMITATIONS
BY-PRODUCT COKEMAKING - IRON AND STEEL PLANTS

Pollutant	Treatment Model Effluent Quality(1)		BPT Effluent Limitations(2)(3)(4)		BCT Effluent Limitations(2)(3)(4)	
	Daily Maximum Concentrations	30-Day Average Concentrations	Daily Maximum Limitations	30-Day Average Limitations	Daily Maximum Limitations	30-Day Average Limitations
Flow, gal/ton	225		-		-	
pH, Units	6.0 to 9.0		6.0 to 9.0		6.0 to 9.0	
Ammonia (N)	291.6	97.2	0.274	0.0912	-	-
Oil & Grease	34.8	11.6	0.0327	0.0109	0.0327	0.0109
Phenols (4AAP)	4.8	1.6	0.00451	0.00150	-	-
Total Suspended Solids	270	140	0.253	0.131	0.253	0.131
121 Cyanide	70.0	23.3	0.0657	0.0219	-	-

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(1) Concentrations are expressed in mg/l unless otherwise noted.

(2) Kg/kkg of coke produced.

(3) Increased loadings, not to exceed 11 percent of the stated limitations are allowed for by-product coke plants which have wet desulfurization systems but only to the extent such systems generate an increased effluent volume.

(4) Increased loadings, not to exceed 27 percent of the stated limitations are allowed for by-product coke plants which include indirect ammonia recovery systems but only to the extent that such systems generate an increased effluent volume.

TABLE II-2

BPT AND BCT MODEL FLOW, MODEL EFFLUENT QUALITY AND EFFLUENT LIMITATIONS
BY-PRODUCT COKEMAKING - MERCHANT PLANTS

Pollutant	Treatment Model Effluent Quality(1)		BPT Effluent Limitations(2)(3)(4)		BCT Effluent Limitations(2)(3)(4)	
	Daily Maximum Concentrations	30-Day Average Concentrations	Daily Maximum Limitations	30-Day Average Limitations	Daily Maximum Limitations	30-Day Average Limitations
Flow, gal/ton	240		-		-	
pH, Units	6.0 to 9.0		6.0 to 9.0		6.0 to 9.0	
Ammonia (N)	291.6	97.2	0.292	0.0973	-	-
Oil & Grease	34.8	11.6	0.0348	0.0116	0.0348	0.0116
Phenols (4AAP)	4.8	1.6	0.00481	0.00160	-	-
Total Suspended Solids	270	140	0.270	0.140	0.270	0.140
121 Cyanide	70.0	23.3	0.0701	0.0233	-	-

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(1) Concentrations are expressed in mg/l unless otherwise noted.
(2) Kg/kkg of coke produced.
(3) Increased loadings, not to exceed 10 percent of the stated limitations are allowed for by-product coke plants which have wet desulfurization systems but only to the extent such systems generate an increased effluent volume.
(4) Increased loadings, not to exceed 25 percent of the stated limitations are allowed for by-product coke plants which include indirect ammonia recovery systems but only to the extent that such systems generate an increased effluent volume.

TABLE II-3

BAT AND NSPS MODEL FLOW, MODEL EFFLUENT QUALITY AND EFFLUENT LIMITATIONS AND STANDARDS BY-PRODUCT COKEMAKING - IRON AND STEEL PLANTS (BIOLOGICAL TREATMENT SYSTEMS)

	Pollutant	Treatment Model Effluent Quality(1)		BAT Effluent Limitations(2)(3)(4)		NSPS Effluent Standards(2)(3)(4)	
		Daily Maximum Concentrations	30-Day Average Concentrations	Daily Maximum Limitations	30-Day Average Limitations	Daily Maximum Limitations	30-Day Average Limitations
	Flow, gal/ton	170		-		-	
	pH, Units	6.0 to 9.0		-		6.0 to 9.0	
	Ammonia (N)	85	25	0.0543	0.0160	0.0543	0.0160
	Oil & Grease	10	-	-	-	0.00638	-
	Phenols (4AAP)	0.1	0.05	0.0000638	0.0000319	0.0000638	0.0000319
	Total Suspended Solids	270	140	-	-	0.172	0.0894
4	Benzene	0.05	0	0.0000319	-	0.0000319	-
55	Naphthalene	0.05	-	0.0000319	-	0.0000319	-
73	Benzo(a)pyrene	0.05	-	0.0000319	-	0.0000319	-
121	Cyanide	10	5.5	0.00638	0.00351	0.00638	0.00351

---

(1) Concentrations are expressed in mg/l unless otherwise noted.

(2) Kg/kkg of coke produced.

(3) Increased loadings, not to exceed 16 percent of the stated limitations and standards are allowed for by-product coke plants which have wet desulfurization systems but only to the extent such systems generate an increased effluent volume.

(4) Increased loadings, not to exceed 39 percent of the stated limitations and standards are allowed for by-product coke plants which include indirect ammonia recovery systems but only to the extent that such systems generate an increased effluent volume.

TABLE II-4

BAT AND NSPS MODEL FLOW, MODEL EFFLUENT QUALITY AND EFFLUENT LIMITATIONS AND STANDARDS BY-PRODUCT COKEMAKING - MERCHANT PLANTS (BIOLOGICAL TREATMENT SYSTEMS)

		Treatment Model Effluent Quality(1)		BAT Effluent Limitations(2)(3)(4)		NSPS Effluent Standards(2)(3)(4)	
	Pollutant	Daily Maximum Concentrations	30-Day Average Concentrations	Daily Maximum Limitations	30-Day Average Limitations	Daily Maximum Limitations	30-Day Average Limitations
	Flow, gal/ton	170		-		-	
	pH, Units	6.0 to 9.0		-		6.0 to 9.0	
	Ammonia (N)	85	25	0.0603	0.0177	0.0603	0.0177
	Oil & Grease	10	-	-	-	0.00709	-
	Phenols (4AAP)	0.1	0.05	0.0000709	0.0000355	0.0000709	0.0000355
	Total Suspended Solids	270	140	-	-	0.192	0.0993
4	Benzene	0.05	0	0.0000355	-	0.0000355	-
55	Naphthalene	0.05	-	0.0000355	-	0.0000355	-
73	Benzo(a)pyrene	0.05	-	0.0000355	-	0.0000355	-
121	Cyanide	10	5.5	0.00709	0.00390	0.00709	0.00390

---

(1) Concentrations are expressed in mg/l unless otherwise noted.
(2) Kg/kkg of coke produced.
(3) Increased loadings, not to exceed 15 percent of the stated limitations and standards are allowed for by-product coke plants which have wet desulfurization systems but only to the extent such systems generate an increased effluent volume.
(4) Increased loadings, not to exceed 35 percent of the stated limitations and standards are allowed for by-product coke plants which include indirect ammonia recovery systems but only to the extent that such systems generate an increased effluent volume.

TABLE II-5

BAT MODEL FLOW, MODEL EFFLUENT QUALITY AND EFFLUENT LIMITATIONS
BY-PRODUCT COKEMAKING - IRON AND STEEL AND MERCHANT PLANTS (PHYSICAL/CHEMICAL TREATMENT SYSTEMS)

				Iron and Steel Plants		Merchant Plants	
		Treatment Model Effluent Quality[(1)]		BAT Effluent Limitations[(2)(3)]		BAT Effluent Limitations[(2)(3)]	
	Pollutant	Daily Maximum Concentrations	30-Day Average Concentrations	Daily Maximum Limitations	30-Day Average Limitations	Daily Maximum Limitations	30-Day Average Limitations
	Flow, gal/ton:						
	Iron & Steel	103		-		-	
	Merchant	120		-		-	
	Ammonia (N)	150	75	0.0645	0.0322	0.0751	0.0375
	Phenols (4AAP)	0.2	0.1	0.0000859	0.0000430	0.000100	0.0000501
4	Benzene	0.05	-	0.0000215	-	0.0000250	-
55	Naphthalene	0.05	-	0.0000215	-	0.0000250	-
73	Benzo(a)pyrene	0.05	-	0.0000215	-	0.0000250	-

---

(1) Concentrations are expressed in mg/l unless otherwise noted.

(2) Kg/kkg of coke produced.

(3) Increased loadings, not to exceed 24 percent of the stated limitations for iron & steel plants, and 21 percent of the stated limitations for merchant plants are allowed for by-product coke plants which have wet desulfurization systems but only to the extent such systems generate an increased effluent volume.

TABLE II-6

PSES AND PSNS MODEL FLOW, MODEL EFFLUENT QUALITY AND EFFLUENT STANDARDS BY-PRODUCT COKEMAKING - IRON AND STEEL PLANTS

Pollutant	Treatment Model Effluent Quality (1)		PSES Effluent Standards (2)(3)(4)		PSNS Effluent Standards (2)(3)(4)	
	Daily Maximum Concentrations	30-Day Average Concentrations	Daily Maximum Limitations	30-Day Average Limitations	Daily Maximum Limitations	30-Day Average Limitations
Flow, gal/ton	103		-		-	
Ammonia (N)	150	75	0.0645	0.0322	0.0645	0.0322
Phenols (4AAP)	100	50	0.0430	0.0215	0.0430	0.0215
121 Cyanide	40	20	0.0172	0.00859	0.0172	0.00859

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(1) Concentrations are expressed in mg/l unless otherwise noted.

(2) Kg/kkg of coke produced.

(3) Increased loadings, not to exceed 24 percent of the stated standards are allowed for by-product coke plants which have wet desulfurization systems but only to the extent such systems generate an increased effluent volume.

(4) Increased loadings, not to exceed 58 percent of the stated standards are allowed for by-product coke plants which include indirect ammonia recovery systems but only to the extent that such systems generate an increased effluent volume.

TABLE II-7

PSES AND PSNS MODEL FLOW, MODEL EFFLUENT QUALITY AND EFFLUENT STANDARDS
BY-PRODUCT COKEMAKING - MERCHANT PLANTS

Pollutant	Treatment Model Effluent Quality(1)		PSES Effluent Standards(2)(3)(4)		PSNS Effluent Standards(2)(3)(4)	
	Daily Maximum Concentrations	30-Day Average Concentrations	Daily Maximum Limitations	30-Day Average Limitations	Daily Maximum Limitations	30-Day Average Limitations
Flow, gal/ton	120		-		-	
Ammonia (N)	150	75	0.0751	0.0375	0.0751	0.0375
Phenols (4AAP)	100	50	0.0501	0.0250	0.0501	0.0250
121 Cyanide	40	20	0.0200	0.0100	0.0200	0.0100

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(1) Concentrations are expressed in mg/l unless otherwise noted.

(2) Kg/kkg of coke produced.

(3) Increased loadings, not to exceed 21 percent of the stated standards are allowed for by-product coke plants which have wet desulfurization systems but only to the extent such systems generate an increased effluent volume.

(4) Increased loadings, not to exceed 50 percent of the stated standards are allowed for by-product coke plants which include indirect ammonia recovery systems but only to the extent that such systems generate an increased effluent volume.

COKEMAKING SUBCATEGORY

SECTION III

INTRODUCTION

General

Cokemaking operations include by-product recovery and beehive facilities. Nearly all of the metallurgical coke produced in the United States is made in by-product recovery coke ovens which operate as part of integrated steel mill complexes. By-product recovery facilities are also used by merchant coke manufacturers, sometimes as part of a chemical or utility plant operation. A very small portion is still made in non-recovery type ovens with arched roofs that closely resemble beehives, hence the name beehive cokemaking operations.

Both types of cokemaking facilities are capable of producing high quality metallurgical coke for use in blast furnaces or in foundry cupolas. Only the by-product recovery coke ovens are equipped to produce a wide variety of other products in addition to coke. Further details on each process and the respective pollutant loads are presented in subsequent discussions.

Data Collection Activities

In addition to evaluating data from previous studies, EPA issued Data Collection Portfolios (DCPs) to all by-product cokemaking facilities known to be active at the time questionnaires were distributed. Responses were received from all facilities. Since that time, three other small independent plants have been reported producing coke, and four of the original respondents have closed permanently. There are currently 58 by-product cokemaking plants and one beehive cokemaking plant in operation. The DCPs distributed for the by-product coke plants requested information about production processes and rates, process water usage and discharge rates, wastewater treatment and disposal methods, age of plants (first year of on-site production and dates of rebuilds), age of treatment systems, and location.

The Agency did not seek any additional data regarding beehive operations. The previously promulgated BPT limitations required no discharge of process wastewater pollutants. The Agency did not receive any comments from industry during the rulemaking process which questioned the appropriateness of that limitation.

Based upon DCP responses and other information, EPA issued Detailed Data Collection Portfolios (D-DCPs) to nine by-product coke plants. These D-DCPs focused upon obtaining cost and operating performance data for wastewater treatment facilities.

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In addition to the questionnaire responses, the Agency reviewed its sampling data from prior studies of four coke plants, and sampled five additional plants for this study. The Agency also performed sampling and analyses as described in Volume I.

As shown in Table III-1, the expanded data base for by-product cokemaking includes EPA sampling at nine plants (15% of plants; representing 20% of industry capacity), DCP responses from 59 plants (95% of plants; and 99% of capacity) and D-DCP responses from nine plants (15% of the plants; representing 17% of capacity). A list of beehive operations is provided in Table III-2, but only one plant with two batteries of ovens is known to be active.

Cokemaking by the By-Product Recovery Process

The production of metallurgical coke is an essential part of the steel industry, since it provides one of the basic raw materials necessary for the operation of ironmaking blast furnaces. Of the two traditional processes for the manufacture of coke, by-product recovery ovens have virtually eclipsed the beehive ovens in commercial applications. Less than 1% of the metallurgical coke produced in 1978 was made in beehive ovens. The remaining 99+% of coke production came from coke plants practicing varying degrees of by-product recovery (64 plants at 59 locations, some with 2 or 3 plants per location, in 17 different states).

The by-product recovery process, as the name implies, not only produces high-quality coke for use as blast furnace or foundry fuels and carbon sources, but also provides a means of recovering valuable by-products of the distillation reaction. During this process, air is excluded from the coking chambers, while heat is supplied from the external combustion of fuel gases in flues located within dividing walls separating adjacent ovens.

The volatile components are recovered from the coke oven gas stream and processed in a wide variety of ways to produce tars, light oils, phenolates, ammonium compounds, naphthalene, and other materials of value, including the coke oven gas itself. Table III-3 summarizes by-product recovery processes in use at the 59 locations where such cokemaking operations exist in the United States. Note that all coke oven gas and crude coal tars are recovered at all plants, and crude light oils, ammonium compounds and naphthalene are recovered at most plants. Of the remaining 23 products, five are produced at only one by-product recovery plant. With one exception, no single plant recovers more than 12 of the 28 products listed.

Beehive cokemaking represents a distinctly different approach to the production of metallurgical coke from the more widely used by-products recovery process. In the beehive process, air is admitted to the oven during the coking cycle so the volatile products which distill from the coal are immediately burned. A small percentage of these products is transferred to the water used to cool the coke (quench). No other water-borne pollutants are generated during the process. For additional details on wastewater characterization and its impact on subcategorization, refer to Sections IV and V.

A by-product recovery coke plant consists of batteries of ovens in which coking coals are heated to drive off volatile components of the coal in the absence of air. The coal used is usually a blend of high, medium and low volatile bituminous grades selected because of specific coking characteristics. The volatiles are drawn off and recovered as by-products during the process. The residue remaining in the oven is the coke product. Typical coking time is 18 hours. The ovens themselves are narrow, rectangular, silica brick chambers arranged side by side in groups of 20 to 90, most often in batteries of 50 to 70 individual ovens. The smallest plants in the industry have a single battery, while the largest has up to 20 batteries with 60-70 ovens in each battery. Most conventional ovens in use today are of similar size, typically 12 meters long, 4.5 meters high, and 0.45 meters wide (approximately 13 x 5 x 0.5 yards). However, new ovens in service and under construction at several American coke plants are 15 meters long, 6 meters high and 0.6 meters wide (approximately 16.4 x 6.6 x 0.66 yards). These larger ovens can accomodate more than twice the coal charges of the smaller ovens, thus producing more coke per charge, and reducing the potential for air emissions while charging and pushing. Additionally, the change in oven design provides the opportunity to install certain other technological improvements including preheating of incoming coal in enclosed chambers; pipeline charging systems using pulverized coal (thus eliminating the need for opening lids atop the ovens while charging and leveling the charge); and the installation of ductwork and shed-type enclosures to capture and clean charging and pushing emissions. Such emission control practices have provided significant improvement in air quality around by-products coke plants. However, these and other similar improvements increase the polluted wastewater load and volume by transferring the air emissions into waters used for scrubbing.

In addition to increases in size of by-product coke ovens, the Agency has noted several trends within this subcategory since the study which formed the basis of the originally promulgated limitations was completed. The indirect ammonia recovery process is used at fewer plants (less than 7% of cokemaking capacity); and, the recovery and refining of light oils to benzene, toluene and xylene is less common. On the other hand, desulfurization of coke oven gas is practiced at more plants, thereby allowing for wider use of the by-product gas as fuel for other steel plant operations. New techniques for gas desulfurization and subsequent recovery of sulfur values have been developed and installed at some coke batteries. Hydrogen sulfides are absorbed using ammonia from coke oven gas together with catalysts in a scrubbing solution. The sulfur-laden solution is then processed into a liquid ammonium sulfate slurry which can be used in fertilizer production or in chemical processes.

The application of required air pollution controls in areas where they were not formerly used is a relatively recent development in cokemaking. For example, the problems associated with noxious emissions from the charging of coal into hot ovens have been addressed on new or rehabilitated ovens by installing pipeline charging of preheated coals, or by equipping larry cars (charging machines) with emission collection and scrubbing systems. The former practice may include exhaust scrubbers on each of the preheaters, while the larry car systems generate considerable volumes of highly contaminated wastewaters which require disposal. Coke pushing emissions are now being controlled by emission collectors and scrubbers, either on enclosed quench cars or in the form of shed enclosures. These latter structures are large collectors of dust-laden gas, some as large as 114 meters long, 18 meters wide and 27 meters high (374 x 60 x 90 feet). At some plants wastewaters blown down from either system are currently used as makeup water for coke quenching. Wet scrubber systems are also in use at coke screening stations and coal preparation, handling and storage areas. All of these systems represent wastewater sources which are new to by-product cokemaking operations, having been installed only within the last few years. More specific details relating to wastewater flows and characteristics are provided in Section V. Process flow diagrams for by-product recovery and light oil refining are shown on Figures III-1 and III-2.

An overall general summary of the by-product cokemaking operations and practices in the United States is provided in Table III-4. Data for age, size, wastewater flow, by-product recovery, wastewater control and treatment technology, and ultimate disposal of wastewaters are highlighted for each by-product coke plant. Wastewaters from several coke plants are discharged to local publicly owned treatment works (POTWs) for final treatment following limited pretreatment on-site. Disposal of contaminated wastewaters by coke quenching is also practiced at several plants. Additional discussion on wastewater flow and disposal follows in Sections V and IX.

Cokemaking By the Beehive Oven Process

This older cokemaking process accounts for less than 1% of the metallurgical coke produced in the United States. Inherent in the beehive process are the significant atmospheric emissions of components of the coal charged to the ovens. With the increased efforts to minimize air pollution nationwide, the use of this operation will continue to decline, since control of emissions places severe constraints on oven operation, making it more difficult to compete on an economical basis with the by-product recovery processes. Refer to EPA-440/I-024a, Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Steelmaking Segment of the Iron and Steel Manufacturing Point Source Category, dated June 1974, Page 36 et seq, for more information on the beehive process. Process flow diagrams for beehive plant operations are shown on Figures III-3 and III-4. Figure III-3 shows a simpler system utilizing quenching within the oven, while Figure III-4 illustrates an external quenching arrangement at a more modern plant.

TABLE III-1

BY-PRODUCT COKEMAKING DATA BASE

	No. of Plants	% of Total No. of Plants	Rated Annual Capacity Reported by Plants (Tons/Year)	% of Total Annual Capacity
Plants Sampled for Original Study	4	6.4	8,327,110	10.9
Plants Sampled for Toxic Pollutant Study	5	8.1	7,091,585	9.2
Total Plants Sampled	9	14.5	15,418,695	20.1
Plants Surveyed Via Detailed DCP	9 incl. 3 above	14.5 incl. 4.8 above	12,972,830 incl. 6,359,760 above	16.9 incl. 8.3 above
Plants Sampled and/or Solicited via Detailed DCP	15	24.2	22,031,765	28.7
Plants Responding to Basic DCP	59(1)	95.2	76,184,260	99.4
Total Plants in Subcategory	62(2)	100.0	76,625,910	100.0

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(1) Four of the original respondents have closed permanently.
(2) Current data base covers 58 active plants. DCP responses are available for 55 plants (74,567,310 tons per year, or 99.4% of present capacity).

TABLE III-2

MAJOR BEEHIVE COKEMAKING OPERATIONS

Plant	Location	No. of Ovens	Status
New York Mining and Manufacturing Company	Calvert, KY	200	Inactive
Sharon Steel, Carpentertown Coal and Coke	Templeton, PA	264	Deactivated Permanently (Sampled in 1973)
Hillman Coal and Coke	Alicia, PA	400	Inactive, and probably dismantled
Rochester and Pittsburgh Coke Company	Lucerne, PA	262	Inactive
Jewell Smokeless Coal Corporation	Vansant, VA	210	Intermittently Active (Sampled in 1973 at two sites.)

NOTE: Active/inactive status of beehive operations varies from month to month. As a result, capacities and production-related data are unavailable.

TABLE III-3

COAL CHEMICALS PRODUCED AT BY-PRODUCT RECOVERY PLANTS

Material Recovered	No. of Plants Practicing Recovery	Percent Practicing Recovery	
		% of No.	% of Coke Prod.
Coke Oven Gas	59	100.0	100.0
Crude Coal Tar	59	100.0	100.0
Crude Light Oils	48	81.4	90.2
Ammonium Sulfate	43	72.9	78.4
Naphthalene Solidifying at <74°C	41	69.5	76.2
Sodium Phenolate (or Carbolates)	25	42.4	46.8
Intermediate Light Oils	20	33.9	43.7
Toluene, all grades	10	16.9	30.4
Benzene, specification grades	9	15.3	27.9
Xylene, all grades	9	15.3	27.3
Solvent Naphtha, all grades	8	13.6	24.4
Elemental Sulfur	8	13.6	22.3
Crude Chemical Oil (Tar Acid Oils)	8	13.6	20.1
30% Ammonium Hydroxide	6	10.2	7.0
Naphthalene solidifying between 74°C and 79°C	4	6.8	22.4
Soft Pitch of Tar	4	6.8	21.0
Enriched Ammonia Liquor	4	6.8	6.5
Benzene, non-specification grades	3	5.1	5.1
Creosote Oils, straight distillate	3	5.1	19.7
Phenol, non-industrial grades	3	5.1	17.2
Hard Pitch of Tar	2	3.4	14.7
Creosote Oils in coal tar solution	2	3.4	11.8
Mono- and Diammonium Phosphates	2	3.4	4.0
Cresols	1	1.7	9.8
Cresylic Acid	1	1.7	9.8
Picolines	1	1.7	9.8
Anhydrous Ammonia	1	1.7	9.8
Phenol, industrial grades	1	1.7	9.8

TABLE III-4

GENERAL SUMMARY TABLE - BY-PRODUCT COKEMAKING

Plant Code No.	First Year Prod.	Rebuild Active Batteries		Production,TPD		Typical Raw(1) Waste Flow		Operations			By-Products			Control & Treatment Tech.						In vs. Ret	Discharge Mode With Typical GPT for each			
		Oldest	Newest	Rated Capacity	Typical	GPD	GPT	NH3	DS. GPT	APT	ØOH	BTX	OTH	ASF	ASL or ASC	DP	Oxidation CH	Oxidation Bio	CA		Direct	POTW	Quench	Other
0012A	1920	1951	1979	(2400)	(1790)	324,000	(181)	1	N	APS	N	C		Y	ASC	N		BOA2		Ret	(148)	0	(117)	
0012B	1919	1966	1967	(1300)	(990)	91,000	(92)	1	N	APS	N	R	(2)	Y	ASC	N		BOA1		Ret	(152)	0	0	
0024A	1916	1967	1979	3480	2578	446,400	173	2	D	APH	Y	C		Y	ASL	Y				Ret	0	173	0	
0024B	1901	1968	1968	2150	2000	86,000	43	N	N	N	N	N		N	N	N				Ret	0	0	0	43(DW); 79(PH)
0060	1953	1953	1977	5150	4890	780,600	160	1	88	APS	Y	R	(2)	Y	ASL	Y				Ret	0	160	0	
0060A	1928	1959	1969	1930	1811	231,800	128	1	25	APS	Y	R	(2)(3)	Y	ASL	Y		BOA1		Ret	131	0	0	
0060F	1943	1950	1953	1045	840	37,000	44	N	N	N	N	N		N	N	N				In	0	0	0	44(CCI)
0112	1914	1951	1976	(5840)	(5058)	840,000	(166)	1	D	APS	N	C	(2)(3)	N(7)	ASL	N		BOA1		Ret	(104)	(<1)	(122)	
0112A	✓1920	1951	1980	9800	9163	834,000	91	1	20	APS	N	R	(2)(3)	N(7)	ASL	N		BOA1		Ret	168	0	0	
0112B	1924	1948	1970	8140	6908	760,000	110	1	8	APS	Y	R	(2)(3)	Y	ASL	Y				In	0	0	47	70(ES)
0112C (R)	1921	1965	1965	1100	998	61,000	61	1	N	APS	Y	C	(2)	N(7)	ASL	N				Ret	0	0	68	
0112C (F)	1926	1948	1952	3500	3028	530,700	175	1	N	APS	Y	C	(2)	Y	ASL	N				Ret	0	0	180	
0112D	1969	1969	1979	6670	5179	488,000	94	1	22	APS	N	N	(2)(3)	N	N	N				In	0	0	51	43(DW)
0174	1914	1952	1976	1000	800	28,800	36	1	N	N	N	N		Y	N	N				In	0	0	0	66(CCI)
0196A	1918	1960	1974	*	*	*	*	1	N	APS	N	R	(2)	I	N	N				In	*	*	*	*
0212	1909	1946	1946	1086	1002	256,500	256	N	D	N	N	N		N	N	N				In	0	256	0	
0248A (4)	1912	1948	1951	1200	1050	134,500	128	1	N	APS	Y	R		Y	ASC	Y				Ret	0	136	0	
0256E	1964	1964	1964	1145	1145	262,000	229	N	N	N	Y	C		N	N	N				No Trt	94	0	139	
0272	1919	1948	1968	3004	3004	312,500	104	1	13	APS	Y	C	(2)	Y	ASL	Y				Ret	43	0	69	
0280B	1929	1963	1963	940	880	173,500	197	1	21	N	N	N	(2)	I	I	N				Ret	0	82	115	
0304	1926	1950	1958	360	Unk	Unk	Unk	1	N	APS	N	N		Y	ASL	N				In	Unk	0	0	
0320	1962	1962	1972	4340	3945	(1,227,600)	(311)	1	N	APP	N	C	(2)	Y	ASL	N				In	0	306	0	6(DW)
0380	1919	1973	1973	400	340	Unk	Unk	1	D	APS	Y	N	(2)	Y	ASL	Y				In	Unk	Unk	0	
0384A -2-	1913	1959	1980	6170	5640	908,000	161	1	N	APS	Y	C	(2)	Y	ASL	Y				In	0	51	110	
0384A -3-	1943	1974	1974	2500	1562	354,600	227	1	D	APS	Y	C	(2)(3)	Y	ASL	Y				In	0	147	92	
0384A -4-	1978	1978	1978	3014	2740	Unk	Unk	1	D	APS	Y	C	(2)(3)	Y	ASL	Y				In	0	Unk	Unk	
0396A	1906	1955	1955	1740	1460	1,584,000	1085	1	N	APS	N	C	(2)	N	N	N	(5)			Ret	0	1085	0	
0396C	1906	1953	1953	814	702	979,300	1395	1	N	APS	N	R	(2)	N	N	N				No Trt	0	1395	0	
0402	1917	1955	1977	*	*	*	*	2	D	APH	Y	R		Y	ASL	Y		BOA1		Ret	*	*	*	*
0426	1920	1958	1979	2760	2400	316,800	132	1	N	APS	N	C	(2)	Y	ASL	N		BOA1		Ret	196	0	0	
0432A	1926	1945	1976	6946	4504	662,000	147	1	N	APS	N	R	(2)	Y	I	N				In	0	0	158	
0432B	1919	1953	1961	5300	5230	743,000	142	1	N	APS	Y	C	(2)	Y	I	Y				Ret	148	0	0	
0448A	1942	1951	1959	4100	3800	201,400	53	1	N	APP	N	C	(2)	Y	I	I				Ret	0	0	60	
0464B	1918	1978	1978	530	500	45,000	90	2	N	APH	N	N		Y	N	N				In	0	96	0	
0464C	1925	1952	1978	615	600	20,000	33	N	N	N	Y	N		N	N	Y	CLA			Ret	0	33	0	
0464E	1914	1970	1979	2100	1272	234,050	184	2	N	APH	N	C		Y	ASL	N		BOA1		Ret	236	0	0	

TABLE III-4
GENERAL SUMMARY
BY-PRODUCT COKEMAKING
PAGE 2

Plant Code No.	First Year Prod.	Rebuild Active Batteries		Production, TPD		Typical Raw(1) Waste Flow		Operations			By-Products			Control & Treatment Tech.						In vs. Ret	Discharge Mode With Typical GPT for each			
		Oldest	Newest	Rated Capacity	Typical	GPD	GPT	NH3	DS. GPT	APT	ØOH	BTX	OTH	ASF	ASL or ASC	DP	Oxidation CH	Oxidation Bio	CA		Direct	POTW	Quench	Other
0492A	1944	1944	1979	1214	690	40,000	58	1	N	APS	N	R	(2)	Y	I	N				Ret	64	0	0	
0538A	1929	1972	1972	450	400	Unk	Unk	1	N	APS	N	C	(2)	Y	ASL	N				In	Unk	0	Unk	
0584B -2-	1953	1953	1981	2590	2500	Unk	Unk	1	840	APS	Y	C	(2)	Y	I	Y				In	0	Unk	Unk	
0584B -3-	1970	1970	1970	2900	2700	Unk	Unk	1	53	APS	Y	C	(2)	Y	I	Y				In	0	Unk	Unk	
0584C	Pre-1921	1946	1979	2640	(2590)	380,700	147	1	42	APS	N	C	(2)	Y	ASL	N		BOA1		In	199	0	0	
0584F (B)	1973	1973	1973	(3600)	(3000)	630,000	(212)	1	D	APS	N	C	(2)(3)	Y	ASC	N		BOA2		In	(237)	0	0	
0584F (M)	1923	1947	1979	(4500)	(4066)	775,000	(191)	1	28	APS	I	C	(2)	Y	ASC	I		BOA2		Ret	(112)	0	(130)	
0656A	1906	1916	1916	650	590	150,500	255	N	N	N	N	N		N	N	N				No Trt	0	136	119	
0684A	1950	1950	1952	2970	2735	244,0900	89	1	N	APS	N	R	(2)	N	N	N				No Trt	0	0	89	
0684B	1923	1948	1979	1852	1279	331,200	259	1	N	APS	N	C	(2)	I	I	N				In	113	0	146	
0684D	1927	1955	1955	576	500	119,500	239	1	N	APS	N	C	(2)	I	I	N				Ret	0	0	0	37(H); 202(L)
0684F -1-	1917	1947	1977	(2764)	(2049)	(277,000)	(135)	1	N	APS	Y	R	(2)	Y	ASC	Y			CAG	Ret	(62)	0	(73)	
0684F -2-	1952	1952	1952	(1954)	(1286)	(157,000)	(122)	1	N	APS	Y	R	(2)	Y	ASC	Y			CAG	Ret	(59)	0	(63)	
0684H	1943	1943	1980	1369	1300	566,800	436	1	N	APS	Y	C	(2)	Y	ASL	Y				In	0	452	0	
0684I	1918	1947	1965	2372	1785	371,300	208	1	N	APS	N	C	(2)	Y	ASL	N		BOA1		Ret	218	0	0	
0684J	1914	1952	1952	1066	560	167,400	299	1	N	APS	N	C	(2)	Y	ASL	N				Ret	309	0	0	
0724F (4)	1920	1920	1920	650	560	318,000	568	1	N	APS	Y	C		Y	ASL	Y				Ret	584	0	0	
0732A	1929	1950	1958	2025	1410	309,000	219	1	20	APS	Y	C		Y	ASL	Y	CLA		CAG	Ret	144	0	82	
0810	1917	1962	1962	*	*	*	*	2	D	APH	Y	C		Y	N	Y				Ret	*	*	*	*
0856A	1918	1948	1980	20780	16,342	2,500,000	153	1	25	APO(6)	Y	R	(2)(3)	Y	ASL	Y		BOA1		Ret	281	0	0	
0856F	1952	1952	2953	3000	3000	270,000	90	1	N	APS	Y	C	(2)	Y	ASL	Y				In	50	0	52	
0856H	1917	1953	1979	4468	4319	450,000	104	1	N	APS	N	C		I	I	I				Ret	0	0	104	
0860A (4)	1915	1950	1952	1580	1262	339,500	269	1	N	APS	N	N		Y	N	N				Ret	166	0	103	
0860B	1911	1949	1979	11960	9750	1,512,000	155	1	N	APS	N	C	(2)	N	N	N				In	0	19	136	
0864A	1944	1944	1979	(3558)	(3520)	(702,700)	(200)	1	N	APS	N	R	(2)	Y	ASL	I				In	0	0	(208)	
0868A	1912	1958	1979	(6866)	(5930)	576,000	(97)	1	N	APS	N	C	(2)	Y	ASL	Y		BOA2		In	(146)	0	0	
0920B	1942	1953	1956	(1200)	(1020)	67,300	(66)	1	N	APS	Y	C	(2)	Y	ASL	Y				Ret	(78)	0	0	
0920F	1917	1945	1976	5205	4310	569,000	132	1	N	APS	Y	C		Y	ASC	I		BOA 1 or 2		Ret	142	0	0	
0946A (4)	1919	1968	1968	1000	700	238,000	340	1	N	APS	N	C		N	N	N				No Trt	0	340	0	
0948A	1916	1954	1980	3816	3483	469,440	135	1	N	APS	Y	C	(2)	I	I	Y				In	0	0	135	
0948C	1919	1955	1961	4000	3406	391,700	115	2	N	APH	Y	C	(2)	Y	ASL	Y				In	0	123	0	

TABLE III-4
GENERAL SUMMARY
BY-PRODUCT COKEMAKING
PAGE 3

-1- Plant 1
-2- Plant 2
-3- Plant 3
-4- Plant 4
(B) Brown's Island
(M) Mainland
(R) Rosedale
(F) Franklin
TPD: Tons per day
GPD: Gallons per day
GPT: Gallons per ton
NH_3: Ammonia Recovery Type
1: Semidirect
2: Indirect
N: No NH_3 Recovery
DS: Desulfurizer Type:
D: Dry
N: No Desulfurizer
Number: Gallons of Wastewater Per Ton of Coke

APT: Ammonia Product Type:
APS: Ammonium Sulfate
APH: Ammonium Hydroxide
APP: Ammonium Phosphate
APO: Other (See Footnotes)
N: No Ammonium Product
ASL or ASC: Fixed Ammonia Still
ASL: Using Lime
ASC: Using Caustic
I: Inactive
N: None
ØOH: Phenol Recovery:
Y: Yes N: No
I: Inactive
BTX Recovery:
C: Crude
R: Refined
N: None
OTH: Other Product Recovered (See Footnotes)
ASF: Free Ammonia Still
Y: Yes N: No
I: Inactive

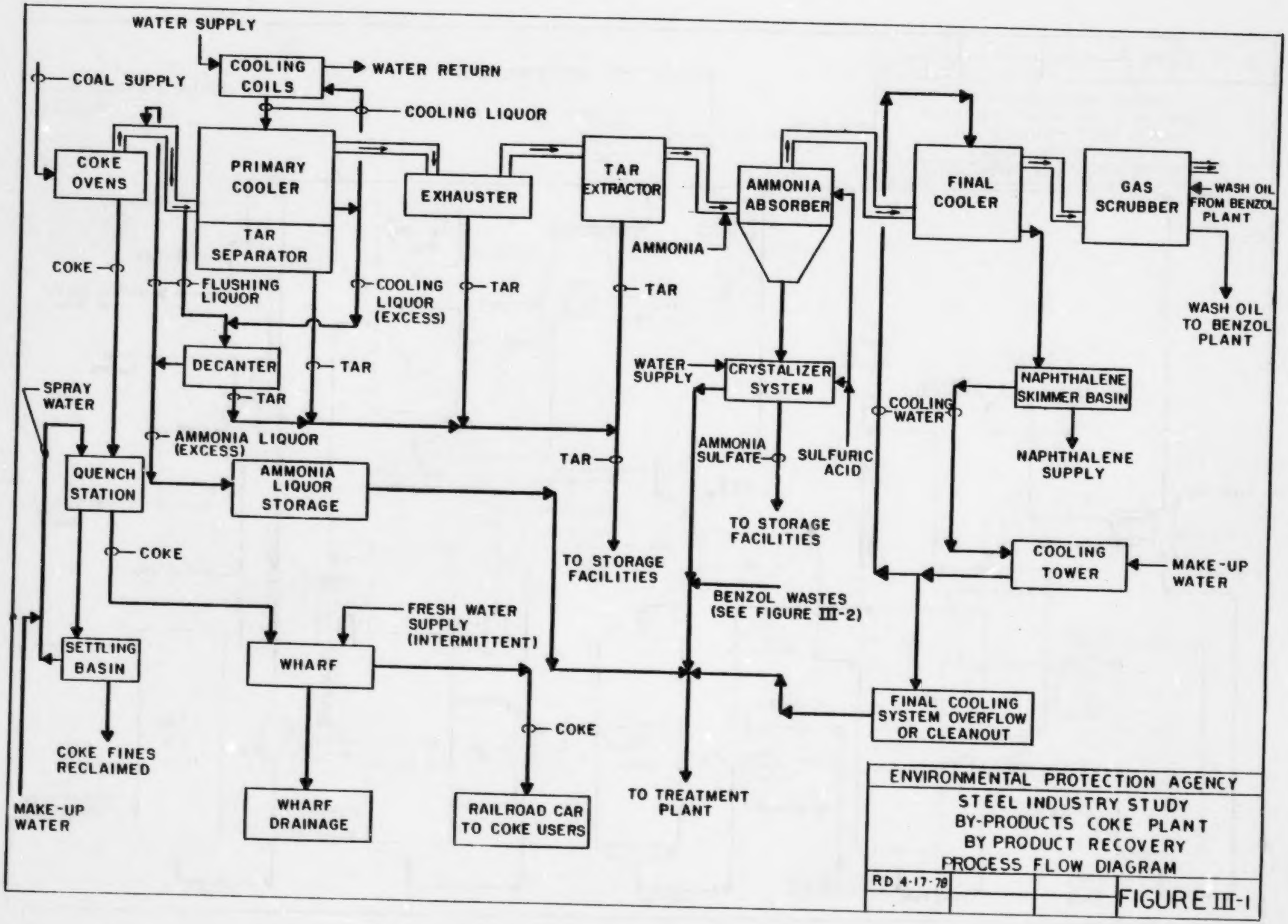
DP: Dephenolizer
Y: Yes
N: No
I: Inactive
CH: Chemical Oxidation
CLA: Alkaline Chlorination
CLB: Breakpoint Chlorination
O: Other (See Footnotes)
BIO: Biological Oxidation
BOA 1: Single Stage
BOA 2: Multi-Stage
CA: Carbon Adsorption (Granular)
In: Initial Installation of Treatment Plant
Ret: Retrofit Installation of Treatment Plant
Unk: Unknown
*: Plant requested confidential treatment of data.

Discharge Mode - Other
DW: Deep Well Disposal
PH: Preheater Make-up Water
CCI: Controlled Combustion Incinerator
ES: Evaporate on Slag
H: Hauled to Treatment at Plant 0684F
L: Impoundment Lagoon

(1) Process Wastewaters Only
(2) Naphthalene
(3) Sulfur
(4) Ceased Operation Permanently
(5) Oxidation Tower
(6) Anhydrous Ammonia
(7) Plant uses Two Fixed Stills

( ) Production and flow data within parenthesis obtained from D-DCP responses or plant visits.

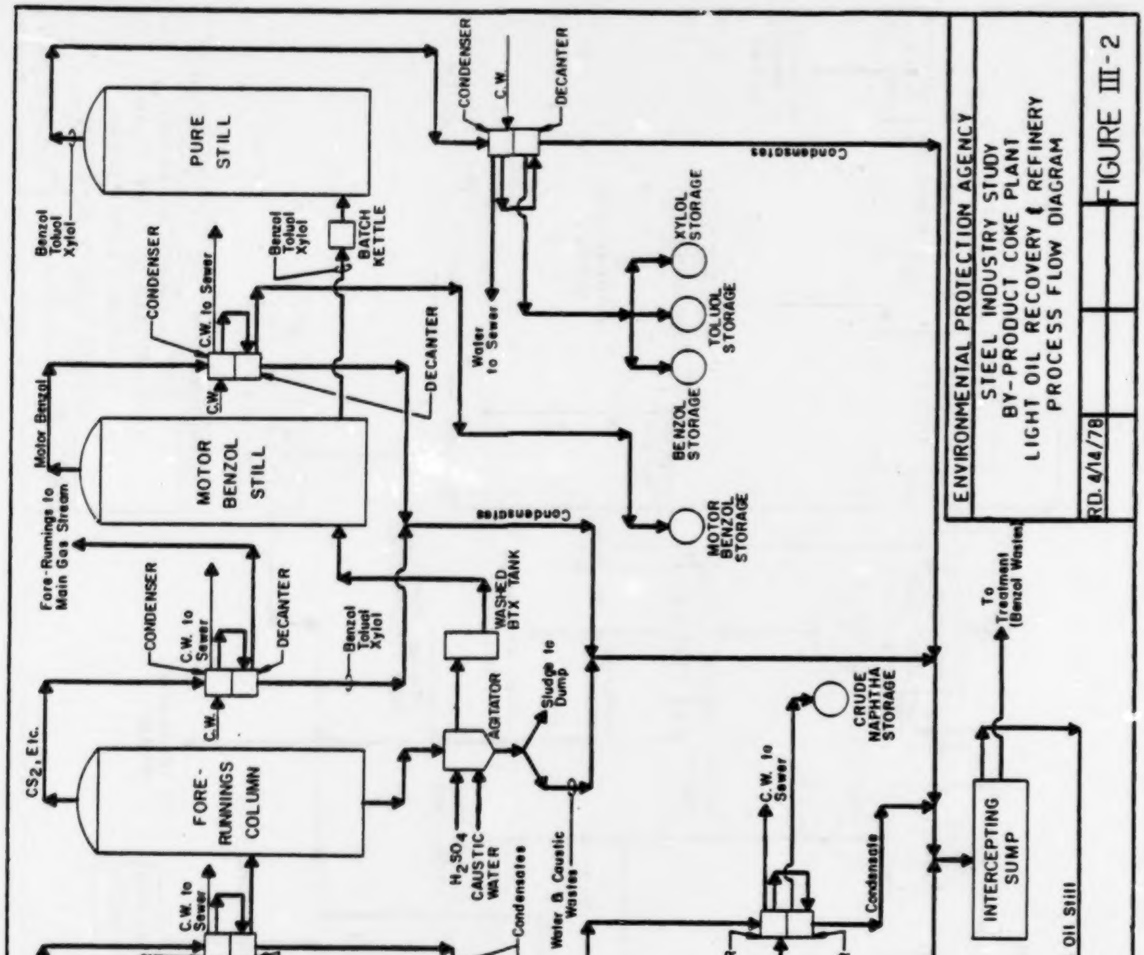
Note: For definitions of other operational and control and treatment codes, refer to Table VII-1.


WATER SUPPLY
COAL SUPPLY
COOLING COILS
WATER RETURN
COOLING LIQUOR
COKE OVENS
PRIMARY COOLER
TAR SEPARATOR
EXHAUSTER
TAR EXTRACTOR
AMMONIA ABSORBER
FINAL COOLER
GAS SCRUBBER
WASH OIL FROM BENZOL PLANT
WASH OIL TO BENZOL PLANT
AMMONIA
COKE
FLUSHING LIQUOR
COOLING LIQUOR (EXCESS)
TAR
TAR
TAR
DECANTER
TAR
TAR
SPRAY WATER
AMMONIA LIQUOR (EXCESS)
QUENCH STATION
AMMONIA LIQUOR STORAGE
TAR
WATER SUPPLY
CRYSTALIZER SYSTEM
AMMONIA SULFATE
SULFURIC ACID
TO STORAGE FACILITIES
COOLING WATER
NAPHTHALENE SKIMMER BASIN
NAPHTHALENE SUPPLY
COOLING TOWER
MAKE-UP WATER
COKE
TO STORAGE FACILITIES
BENZOL WASTES (SEE FIGURE III-2)
FRESH WATER SUPPLY (INTERMITTENT)
SETTLING BASIN
WHARF
COKE
FINAL COOLING SYSTEM OVERFLOW OR CLEANOUT
COKE FINES RECLAIMED
MAKE-UP WATER
WHARF DRAINAGE
RAILROAD CAR TO COKE USERS
TO TREATMENT PLANT
RD 4-17-78

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY-PRODUCTS COKE PLANT
BY PRODUCT RECOVERY
PROCESS FLOW DIAGRAM

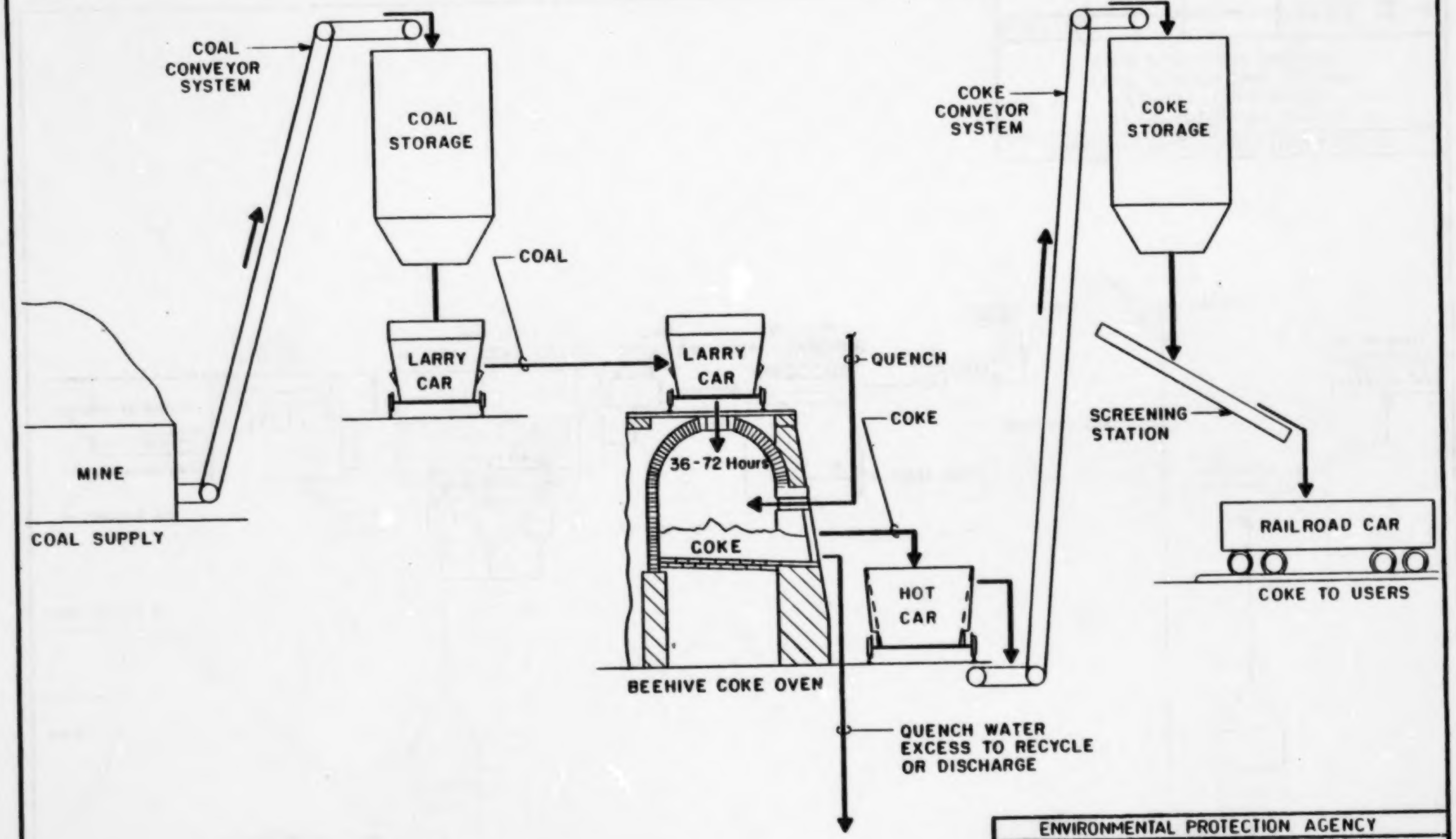
FIGURE III-1


Wash Oil from Gas Scrubbers
Steam
WASH OIL STILL
Light Oil
C.W.
DECANTER
CONDENSER
C.W. to Sewer
Light Oil
Condensate
Wash Oil
Cooling Water to Sewer
COOLER
Cooling Water
Wash Oil to Gas Scrubber
DECANTER
Condensate
LIGHT OIL STORAGE
RECTIFYING COLUMN
CONDENSER
C.W.
DECANTER
C.W. to Sewer
Condensates
Intermediate Light Oil
CRUDE STILL
CRUDE HEAVY SOLVENT
CONDENSER
C.W.
DECANTER
C.W. to Sewer
Condensate
CRUDE NAPHTHA STORAGE
INTERCEPTING SUMP
Oil to Wash Oil Still
To Treatment (Benzol Wastes)
FORE-RUNNINGS COLUMN
CS₂, Etc.
C.W.
CONDENSER
C.W. to Sewer
DECANTER
Fore-Runnings to Main Gas Stream
H₂SO₄
CAUSTIC
WATER
AGITATOR
Sludge to Dump
Water & Caustic Wastes
WASHED BTX TANK
Benzol Toluol Xylol
MOTOR BENZOL STILL
Motor Benzol
C.W.
CONDENSER
C.W. to Sewer
DECANTER
Condensates
Benzol Toluol Xylol
BATCH KETTLE
PURE STILL
Benzol Toluol Xylol
CONDENSER
C.W.
DECANTER
Water to Sewer
Condensates
MOTOR BENZOL STORAGE
BENZOL STORAGE
TOLUOL STORAGE
XYLOL STORAGE
LEGEND:
C.W. - COOLING WATER
RD. 4/14/78

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY-PRODUCT COKE PLANT
LIGHT OIL RECOVERY & REFINERY
PROCESS FLOW DIAGRAM

FIGURE III-2

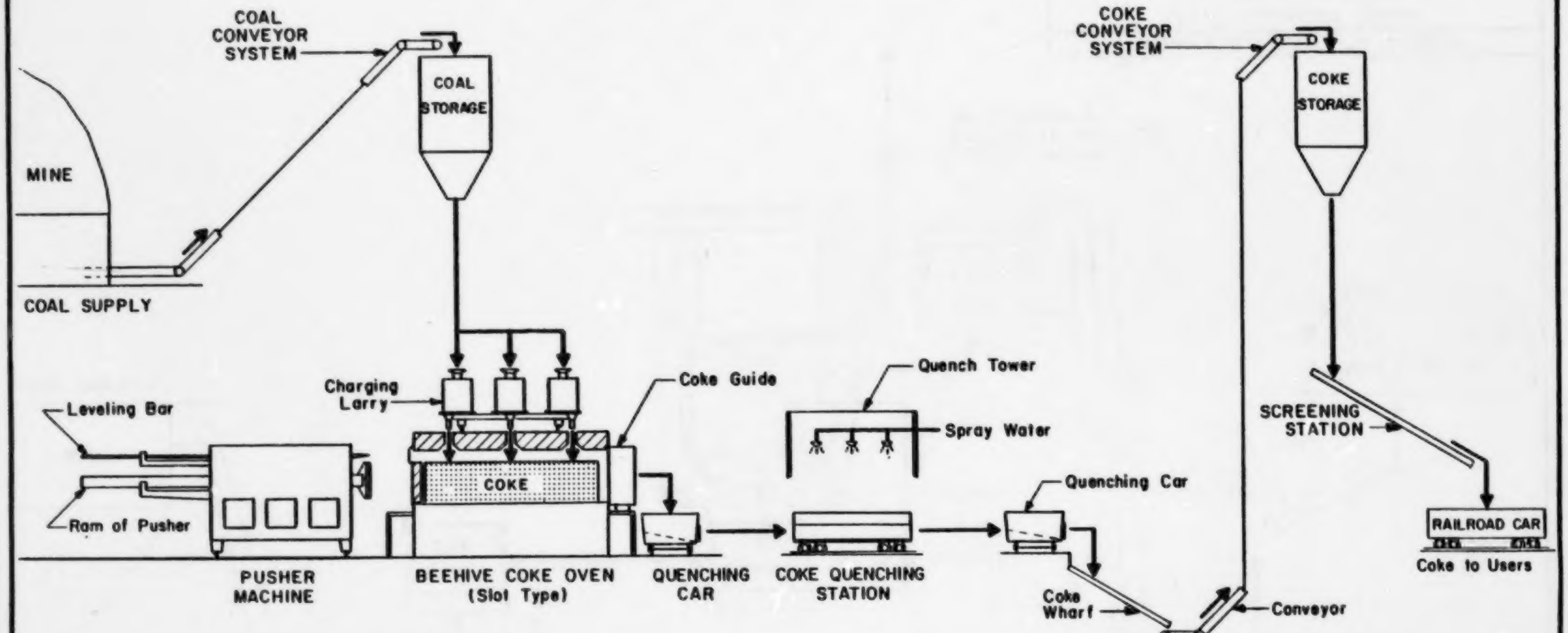

COAL CONVEYOR SYSTEM
COAL STORAGE
MINE
COAL SUPPLY
LARRY CAR
COAL
LARRY CAR
36-72 Hours
COKE
BEEHIVE COKE OVEN
QUENCH
COKE
HOT CAR
QUENCH WATER EXCESS TO RECYCLE OR DISCHARGE
COKE CONVEYOR SYSTEM
COKE STORAGE
SCREENING STATION
RAILROAD CAR
COKE TO USERS

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BEEHIVE COKE PLANT
TYPE I-INTERNAL QUENCH
PROCESS FLOW DIAGRAM

RD. 4/15/78

FIGURE III-3


MINE
COAL SUPPLY
COAL CONVEYOR SYSTEM
COAL STORAGE
Charging Larry
Coke Guide
COKE
Leveling Bar
Ram of Pusher
PUSHER MACHINE
BEEHIVE COKE OVEN (Slot Type)
QUENCHING CAR
Quench Tower
Spray Water
COKE QUENCHING STATION
Quenching Car
Coke Wharf
Conveyor
COKE CONVEYOR SYSTEM
COKE STORAGE
SCREENING STATION
RAILROAD CAR
Coke to Users

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BEEHIVE COKE PLANT
TYPE II-EXTERNAL QUENCH
PROCESS FLOW DIAGRAM

RD. 4/15/78

FIGURE III-4

COKEMAKING SUBCATEGORY

SECTION IV

SUBCATEGORIZATION

Introduction

The Agency subdivided the cokemaking subcategory into by-products recovery and beehive processes because of the basic differences in process equipment and final products. The by-product subdivision was further divided into coke plants affiliated directly with steel production and merchant coke plants. Each of these subdivisions has a segment for existing full scale physical-chemical treatment systems at the BAT level.

The Agency concluded that further subdivisions within each of these processes are not appropriate. The Agency believes that differences in process operations and air cleaning systems which contribute wastewaters are best addressed by establishing basic conditions applicable to all coke plants, and then providing for specific incremental effluent limitations for qualifying plants based upon variations from the basic conditions. Accordingly, the regulation contains allowances for desulfurization using wet absorption methods, and the practice of indirect ammonia recovery, only to the extent necessary to accommodate higher wastewater flows associated with these operations. The model by-product recovery cokemaking production facility includes the coke ovens, associated coke oven gas cleaning equipment, and facilities for recovery of crude coal tars, ammonia compounds, naphthalene, and crude light oil. Tar processing and crude light oil refining operations are not included.

Factors evaluated with respect to subcategorization and subdivision are discussed below in greater detail.

Factors Considered in Subcategorization

Manufacturing Process and Equipment

Major differences between the production equipment used and the nature of the cokemaking process form the basis for subdividing cokemaking into by-products and beehive operations. In the by-products recovery ovens, the exclusioh of air and the use of flushing liquor to condition coke oven gas generates significant quantities of various types of wastewaters. The most highly contaminated of these wastewaters originates from the moisture of the coal itself, and takes the form of excess flushing liquor which must be continuously removed from the flushing liquor system. This same moisture is vaporized in the beehive process, along with other volatile constituents of the coal. Air is admitted into the ovens to burn these volatiles to provide additional heat for the coking process. The Agency found no significant differences in manufacturing processes and production equipment between by-product coke plants associated directly with steel production and merchant coke plants which are used to produce coke for a variety of uses.

Since there are basic differences in manufacturing process, it follows logically that the process equipment likewise differs between beehive and by-products recovery operations. The beehive operations are much simpler than the by-product operations. Both processes have coke quenching in common, but the by-product recovery process also may include operations such as ammonia recovery, dephenolization, desulfurization, light oil refining and scrubbing of emissions from coal and coke handling, coal charging, and coke pushing. These additional processing operations and variations in equipment cause enough differences in wastewater quantity, quality and treatability to warrant separate limitations for by-product and beehive cokemaking processes even though both start with the same raw material; coal. Within the by-product cokemaking operations, variations in manufacturing process and equipment relate directly to the by-products recovered. However, wastewaters from all operations at a given site are usually combined and treated in a single treatment system. Where appropriate, incremental effluent limitations for by-product recovery are provided over and above the basic effluent limitations for all plants.

Final Products

Although both processes have the production of coke as their primary objective, the by-products recovery cokemaking operations (including merchant coke production) yield a wide variety of final products, including coke oven gas, and crude coal tars (see Section III, Table III-3). The basic products can differ from plant to plant. The coke itself can be either furnace coke for use in blast furnace iron-making, or foundry coke for cupola use. Coke oven gas can vary depending on the chemical composition of the coals coked and the degree of cleaning and conditioning provided for the gas prior to its ultimate use. These factors will also influence the quality of the coal tars recovered. Other recovered by-products will determine the volume and quality of certain wastewater streams. For example, most by-products plants use semi-direct ammonia recovery methods producing ammonium sulfate or ammonium phosphate. However, six by-product plants use indirect methods which produce ammonium hydroxide instead. This latter process yields larger volumes of wastewater than do semi-direct recovery methods. There are other differences in wastewater generation rate and quality resulting from recovery of crude or refined light oils, from sulfur recovery, from dephenolization, and from final cooler operations, whether recycled or once-through. Impacts from these variations are discussed in more detail in Sections IX and X. The Agency believes that it has properly accounted for the plant to plant variations in wastewater quantity and quality caused by the production of different final products with the building block approach used to develop the effluent limitations and standards.

There are no such variations for beehive operations, which generate less noxious wastewaters. As a result, the Agency believes that the basic subdivision of cokemaking into beehive and by-products recovery processes is appropriate in part because of the diverse final products produced by the latter operations.

Raw Materials

While raw materials are a principal factor in subcategorizing the steel industry, the coals used in the cokemaking subcategory have no significance on segmenting the cokemaking subcategory. Although variations in coal chemistry affect wastewater quality and quantity, other factors such as the presence or absence of by-products recovery components and air pollution emission controls are of much greater significance with respect to the generation of wastewater requiring treatment. Within the by-product cokemaking segment (iron and steel and merchant cokemaking), coals are blended to provide the most desired combination of characteristics in the end product. Thus, the generation of wastewaters requiring control and treatment is influenced by other factors to a much greater extent than by variations in raw material charged to the ovens. These influences are adequately covered by incremental effluent limitations where appropriate. Accordingly, the Agency has not subdivided or segmented by-product recovery operations on the basis of raw materials.

Wastewater Characteristics

As indicated above in the discussion of manufacturing processes, beehive and by-product cokemaking operations generate significantly different wastewaters. Process wastewaters from beehive operations are related strictly to quenching operations, and as such are readily treated by sedimentation for removal of suspended solids. The excess quench water is collected and evaporated on the hot coke product. The volume of wastewaters generated by the beehive process vary only slightly from plant to plant.

The by-product recovery processes, on the other hand, generate excess flushing liquors, benzol plant wastewaters, final cooler wastewaters, desulfurizer wastewaters, air pollution control scrubber effluents and tar decanter wastewaters in addition to the wastewaters from quenching operations. In contrast to beehive operations, these wastewaters contain pollutants other than suspended solids such as ammonia-N, cyanides, phenolic compounds, sulfides, oil and greases, acids and alkalis, as well as many toxic organic pollutants. While the Agency found plant to plant variations in the quality of untreated cokemaking wastewaters, the Agency determined that these differences are not significant in terms of further subdividing or segmenting by-product cokemaking operations. The Agency did not find significant differences between wastewaters from iron and steel and merchant coke plants and has not segmented the by-product recovery subdivision on the basis of wastewater characteristics. For more details on cokemaking wastewater characteristics refer to Section V.

Wastewater Treatability

Wastewaters from beehive cokemaking operations are effectively treated by simple sedimentation in settling ponds to remove coke fines picked up during quenching. Pond overflows are readily recycled to the quenching operation, with minimal impact on air quality due to the general absence of pollutants other than suspended solids.

Based upon data obtained from several by-product cokemaking operations, the Agency found plant to plant variations in wastewater quality and quantity. However, for both merchant cokemaking operations and those affiliated with steel production, the Agency found no variations in either the quantity or the quality of the wastewaters which would affect subcategorization or further subdivision of cokemaking operations beyond that provided by the subdivision into merchant and iron and steel cokemaking operations. The distinction made between merchant and iron and steel cokemaking operations was made on the basis of flow as noted below.

Size and Age

Consideration was given to the impact of size and age when subdividing the cokemaking subcategory into beehive and by-product operations. Beehive plants tend to be only about one-fifth as large as iron and steel affiliated by-products plants. Although the beehive process is an older technology, the only beehive plant known to be active is "newer" than many by-product plants. Thus, these size and age differences are covered by the basic subdivision into two manufacturing processes. Within the by-product cokemaking segment, differences in age betweeen merchant and iron and steel coke plants are not significant. However, merchant coke plants tend to be smaller in size and, as a group, have slightly higher water use rates.

With respect to size expressed as rated capacity, the ratio between the largest and smallest direct discharge by-product cokemaking facilities for which flow data are available is 32:1, yet the corresponding ratio between total daily raw waste flows for those two plants is less than 8:1. The Agency did not find any relationship between flow rates per unit of production and size except for the merchant segment, as noted above. The total raw wastewater generation rates reported for the six largest steel-owned direct discharge plants and the three largest POTW users averaged 150 GPT, while the corresponding number of smallest plants averaged 159 GPT. Similarly, for merchant plants, the three largest direct dischargers plus the two largest POTW users averaged 162 GPT, while the corresponding smallest merchant plants averaged 172 GPT. The range of flows for large plants is narrower than for small, primarily because the larger ones practice similar degrees of by-product recovery while different degrees of by-product recovery is practiced at the smaller plants. As noted above, these differences are accounted for by incremental effluent limitations within the by-product segment rather than by further segmentation on the basis of size.

Scatter diagrams of by-product cokemaking plants plotting rated capacity versus flow, and identifying those which discharge either directly or indirectly are illustrated in Figures IV-1 and IV-2. Note that most plants, large and small, are generating wastewater at less than 250 gal/ton, indicating that size has little impact on flow.

The Agency did not find any impact relating to the age of a coke plant other than the indirect one derived from the subdivision into by-product recovery and beehive segments. To begin with, age itself is a relative term, since most coke plants have been in operation much longer than their current "oldest" active production units. Data from all by-product recovery plants are also plotted in Figures IV-1 and IV-2, showing the year of rebuild for the oldest active battery on-site versus flow for each plant. Many sites show oldest active batteries built between 1940 and 1962. Flows are not dependent on year of rebuild, since both high and low flows occur in every age group, indicating that age has no impact on flow. Further support can be shown by comparing wastewater generation rates for old and new plants. Defining age by "oldest active battery", the five oldest plants average 191 GPT, while the five newest average 205 GPT, a difference of only 7%. If age is defined as "first date of cokemaking on-site", these flows are 175 GPT for old plants and 185 GPT for new plants. The Agency believes that these differences are not significant.

Plants vary from 9 to 81 years old if first year of operation is the criterion for age, or from 1 to 66 years old if oldest active battery is considered. The oldest site, 81 years, is only 14 years old if oldest active battery is selected as the criterion for "age". The available data for age demonstrates that the "average" by-product cokemaking plant has had cokemaking on-site for at least 50 years, although the oldest active batteries are 26 years old and the newest only a few years old. Wastewater treatment systems (other than those which are purely by-product recovery system components) date back 12 to 15 years, and have usually been upgraded within the last 6 to 8 years.

The Agency also found that age does not have a significant impact on wastewater characteristics or treatability. Among the surveyed plants, the newest and best treatment facilities were found at three locations which have been making coke for more than 70 years, with active batteries at least 25 years old. Also, to further complicate the concept of plant age, there can be a significant distinction between active campaign years and calendar years. The former involves actual use of a battery of ovens, which may be only 20 years during a 35 calender year period. The need to rebuild major portions of an operating coke plant at various intervals provides an opportunity to install or upgrade wastewater treatment components with minimal disruption to the remaining process operations. A review of DCP responses indicates that 68% of the plants provided some upgrading of wastewater treatment equipment to coincide with the rebuild of active batteries.

In response to the Court's remand, the Agency compared industry's actual cost for pollution control facilities with its estimated model plant costs. The objective of the comparison was to determine the relative ease with which the model wastewater technology equipment can be retrofitted to existing systems and production units. Based on that comparison, the Agency concludes that its model cost estimates are sufficiently generous to cover the associated retrofit costs for plants of all "ages." As additional support, a review of the list of plant ages versus installation dates for treatment systems confirms that most plants can and do retrofit treatment systems to existing production facilities (Refer to Table IV-1).

Based upon the above, the Agency finds that both old and newer by-product cokemaking production facilities generate similar raw wastewater pollutant loadings; that pollution control facilities can be and have been retrofitted to both old and newer cokemaking facilities without substantial retrofit costs; that these pollution control facilities can and are achieving the same effluent quality; and, that further subcategorization or further segmentation within this subcategory on the basis of age or size is not appropriate.

Geographic Location

The Agency has concluded that location does not have a significant effect upon subcategorization or further subdivision, other than the fact that beehive ovens tend to be located in rural areas within bituminous coalfields (Pennsylvania, West Virginia, Virginia and Kentucky), while by-products recovery plants are situated at locations where their by-product gas can be used as fuel (i.e., at integrated steel works, or urban areas where gas can be distributed to other users). The Agency accounts for this distinction by subdividing the cokemaking subcategory into by-products and beehive processes.

By-product cokemaking operations need no further segmentation because of location. By-product recovery plants are situated in 17 states, but half of the total number are found in Pennsylvania, Ohio, and Alabama. Only six are located west of the Mississippi River (2 in Texas, 1 each in California, Colorado, Missouri, and Utah). The Agency did not find any significant differences due to geographic location. The effect of location in terms of water consumption in arid or semi-arid regions is discussed in Section VIII.

Process Water Usage

For beehive operations, flows are a function of the quenching rate, and are uniform from plant to plant. Excess quench water is collected and recycled to the operation, thus minimizing the need for makeup water. The Agency did not observe any variations in process water usage, and, accordingly, believes a single model flow suffices for beehive operations.

The raw wastewater flows reported to EPA for by-product cokemaking installations vary considerably from plant to plant, with a low of 33 gallons per ton of coke to a high of 1395 gallons per ton. These flows include process wastewaters only as non-contact cooling waters were excluded by the Agency from total reported flows where possible. These variations in flow reflect the different water use and conservation practices at cokemaking operations. Plants that have low flows also have minimum recovery of by-products, and rarely have any auxiliary equipment such as charging or pushing emission control scrubbers or desulfurizers. As noted above, the Agency did find that merchant coke plants tend to have slightly higher wastewater flow rates than coke plants affiliated directly with iron and steel production.

The Agency believes these flow variations have been properly accounted for by providing incremental effluent limitations where appropriate rather than by further subdivision based upon wastewater flow rate. These limitations are provided for plants practicing indirect ammonia recovery and wet gas desulfurization and are in addition to the base limitations applicable to all plants. Variations in flow can be reduced by implementing the wastewater recycle components included in the model BPT and BAT treatment systems. These are recycle of final cooler water, ammonium sulfate barometric condenser water, and recycle of air pollution control system scrubber waters. Additional discussion of these water usage and wastewater generation flow rates is provided in subsequent sections, particularly in Section V.

Consideration of Process Changes

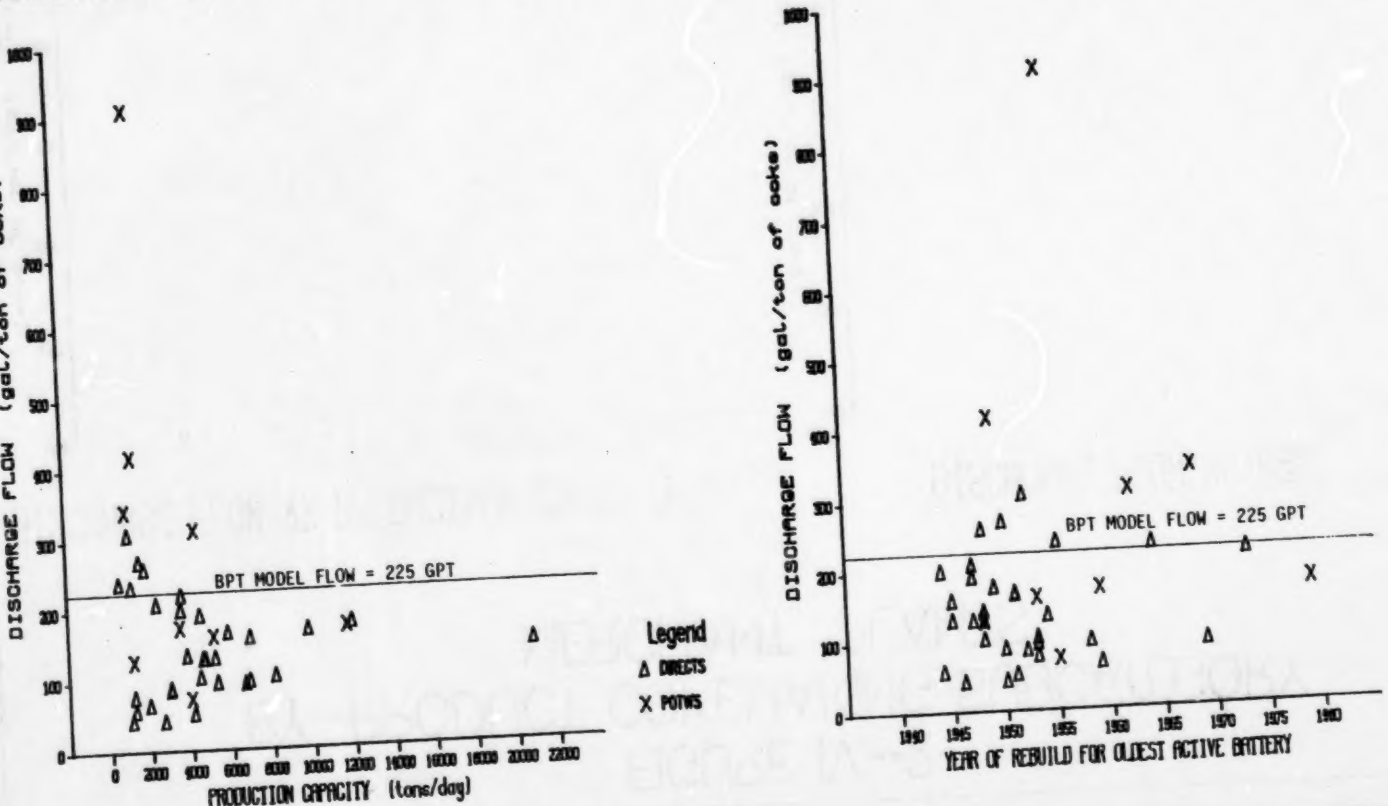
The BAT model treatment system does not include any in-process changes although wastewater quality may change when discharge rates are reduced. Many plants are employing recycle, reuse or treatment and recycle to minimize water use and the volume of effluents discharged. The limitations and standards are mass limitations and standards (unit weight of pollutant discharged per unit weight of product) and not volume or concentration limitations and standards. While the limitations and standards can be achieved by extensive treatment of large flows, the Agency believes that the limitations and standards can, in most instances, be achieved more economically by minimizing effluent volumes prior to final treatment.

TABLE IV-1

EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED THE ABILITY TO RETROFIT POLLUTION CONTROL EQUIPMENT COKEMAKING SUBCATEGORY

		Age of Production Facilities				Age of Treatment System		
Cokemaking Process	Plant Reference Number	First Year On-Site (Year)	Active Batteries Oldest (Year)		Active Batteries Newest (Year)	Installed (Year)		Upgraded (Year)
Beehive	0428A-1	~1930	1963		1970	-	1970	-
	0428A-2	~1930	1970		1970	1970		1973
	0724G	~1920	-	1960	-	1960		1968
By-Product Recovery	0012A	1920	1951		1979	-	1977	-
	0012B	1919	1966		1967	1974		1979
	0024A	1916	1967		1979	1972		1978
	0024B	1901	-	1968	-	1969		1977
	0060	1953	1953		1977	1953		1977
	0060A	1928	1959		1969	1947		1978
	0112	1914	1951		1976	1962		1979
	0112A	~1920	1951		1980	1976		1980
	0112C	1921	1948		1965	-	1978	-
	0248A	1912	1948		1951	-	1971	-
	0272	1919	1948		1968	1957		1977
	0280B	1929	1963		1963	-	1977	-
	0396A	1906	-	1955	-	-	1972	-
	0402	1917	1955		1977	1917		1971
	0448A	1942	1951		1959	-	1973	-
	0464C	1925	1952		1978	-	1971	-
	0464E	1914	1970		1979	1914		1978
	0584F-M	1923	1947		1979	1976		1979
	0684D	1927	-	1955	-	-	1975	-
	0684F	1917	1947		1977	1960		1976
	0684I	1918	1947		1965	1970		1974
	0684J	1914	-	1952	-	-	1976	-
	0732A	1929	1950		1958	1952		1979
	0810	1917	-	1962	-	-	1975	-
	0856A	1918	1948		1980	-	1975	-
	0856N	1917	1953		1979	1917		1978
	0920B	1942	1953		1956	1942		1977
	0920F	1917	1945		1976	-	1978	-

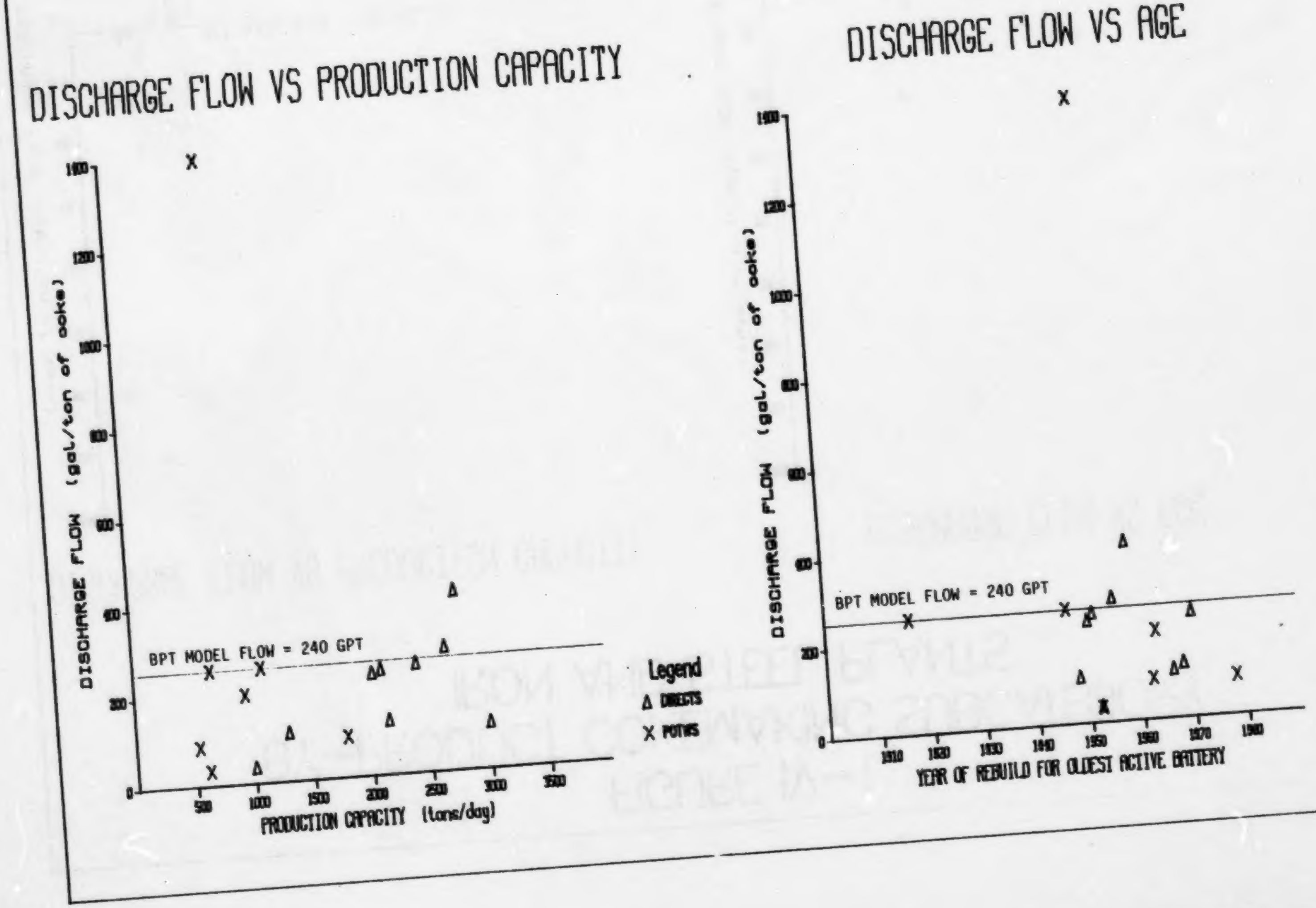
FIGURE IV—1
BY—PRODUCT COKEMAKING SUBCATEGORY
IRON AND STEEL PLANTS



DISCHARGE FLOW VS PRODUCTION CAPACITY

DISCHARGE FLOW VS AGE

FIGURE IV–2
BY–PRODUCT COKEMAKING SUBCATEGORY
MERCHANT PLANTS



COKEMAKING SUBCATEGORY

SECTION V

WATER USE AND WASTEWATER CHARACTERIZATION

Introduction

The sources and characteristics of process wastewaters generated by cokemaking operations are reviewed herein, with particular emphasis on by-product cokemaking wastewaters. Water use rates were measured during field sampling of selected plants, and also were obtained for active by-product plants through DCPs. For the two beehive operations, field data alone were used. Since the only process wastewater source for beehive cokemaking is quenching runoff, and this source is readily recycled, the Agency did not solicit additional data with DCPs from these sources.

Waste characterization for both cokemaking processes is based upon analytical data obtained during the field sampling programs. Long-term data were obtained from selected companies by detailed data collection portfolios (D-DCPs), which were also used to supplement available cost information. Additional data were acquired by EPA regional staff with the cooperation of individual companies, and from the activities of EPA's Office of Research and Development.

Water use rates discussed below pertain only to process wastewaters, and not to non-contact or non-process cooling water. Non-contact cooling water and non-process waters are not limited by this regulation.

Sources

General process and water flow diagrams of a conventional by- product coke plant and associated light oil recovery plant are presented as Figures III-1 and III-2. Typical beehive operations are shown on Figures III-3 and III-4. In actual practice, 75% of the by-product coke plants have some degree of ammonia recovery as shown on Figure III-1, and even more recover crude light oils. However, only about 25% refine light oils to the extent shown on Figure III-2.

The typical products generated during the carbonization of a metric ton (1.1 short tons) of coal in the by-product cokemaking process are as follows:

Coke Oven Gas	350 cu. m	(12,500 cu. ft.)
Tar	35 liters	(9.2 gal)
Ammonia as Nitrogen	2.4 Kg	(5.3 lb)
Tar Acids	2.4 Kg	(5.3 lb)
Hydrogen Sulfide	3.0 Kg	(6.6 lb)
Light Oils	12 liters	(3.2 gal)
Coke - Sized	625 Kg	(1380 lb)
Coke - Undersized	75 Kg	(160 lb)
Water	132 liters	(35 gal)

Although the above list summarizes the typical quantities recoverable from grades of coal commonly used for cokemaking, the Agency observed variations among different coals which are due to differences in coal chemistry, moisture and volatility. For example, the quantities of coke oven gas generated per metric ton of coal coked reported for 58 coke plants varied from 216 to 523 cubic meters per metric ton (7,000 to 16,970 cubic feet per short ton).

Raw wastewater loads from by-product cokemaking operations vary widely, not only as a result of differences in coals used, but also due to variations in recovery processes, water use systems, operating temperatures of the ovens, and the duration of the coking cycle. However, all such variations are subject to effective control by the treatment systems considered herein. Raw wastewater flows generated by the nine by-product coke plants sampled during this study were found to range from 90 to 580 l/kkg (21.6 to 139 gallons per ton) of coke produced. Maximum and minimum effluent flows vary even more widely since several options exist for treating each coke plant wastewater. For example, at most plants with biological treatment systems, some dilution water is added to optimize conditions for the bioxidizing organisms. Also, raw or treated wastewaters are disposed of by coke quenching at some plants. Effluent flows from these plants are lower than from plants where all wastewaters are discharged.

The most significant wastewaters generated during by-product cokemaking and by-product recovery operations are excess ammonia liquor; final cooler wastewater; light oil recovery wastewaters; barometric condenser wastewaters from the crystallizer; desulfurizer wastewaters; and, contaminated wastewaters from air pollution emission scrubbers for charging, pushing, preheating, and screening operations. In addition, miscellaneous wastewaters may result from coke wharf drainage, quench sump overflows, and coal or coke pile runoffs. Runoffs from storage piles and coke wharves should be contained within a diked area and impounded until evaporated, or collected and transferred to the plant's wastewater treatment system. Condensates from drip legs and gas lines, along with leakage from sample test taps and floor washdowns should also be routed to treatment prior to release, since significant toxic pollutant discharges can originate from these diverse sources. Among the possible means for control, the following methods are most applicable:

1. Collection and channeling of miscellaneous sources to process wastewater treatment systems.

2. Impoundment with no discharge, provided that subsurface discharge through percolation is prevented by the use of impervious materials to line lagoons, storage ponds, and runoff collection stations.

3. For situations where the impact on air pollution can be tolerated, a system of recycle to extinction by coke or slag quenching operations may be acceptable.

The largest volumes of water leaving a by-product coke plant are indirect (noncontact) cooling waters from a variety of cooling and condensing operations. These flows are not considered process wastewaters, but leaks in coils or tubes can result in significant contamination of these cooling waters. Frequent inspection and proper maintenance will prevent such contamination from process waters. Inspection and maintenance programs to minimize contamination of non-contact cooling waters can be included in NPDES permits as Best Management Practices (BMPs).

The volume of excess ammonia liquor produced from the distillation of coal varies from 75 to 430 l/kkg (18 to 103 gal/ton) of coke at plants using semi-direct ammonia recovery, and from 260 to 442 l/kkg (62 to 106 gal/ton) at plants using indirect recovery. Ammonia liquor was sampled separately at six coke plants and as part of a mixed flow at two coke plants. Measurements showed excess ammonia liquor flows of 90 to 205 l/kkg (21.6 to 49.3 gal/ton). The pollutants of interest are shown in Table V-1 for the original guidelines survey, and in Table V-2 for the toxic pollutant survey. In order to determine which pollutants are contributed by cokemaking operations, the Agency subtracted the intake concentrations of those pollutants found in the raw wastewaters from the raw wastewater concentrations. Note the major pollutants found in excess ammonia liquor are directly related to the destructive distillation of coal. Since excess flushing liquors represent the first step in cooling the coke oven gas for reuse, the waste ammonia liquor contains by far the greatest pollutant load. All by-products recovery plants generate excess ammonia liquor.

Final cooler wastewaters originate from direct contact cooling of coke oven gas with water sprays which dissolve any remaining soluble gas components and physically flush out condensed naphthalene crystals. Final cooler wastewater volume ranges from 190 to 820 l/kkg (46 to 197 gal/ton), but this volume can be and is reduced to between 8.3 and 42 l/kkg (2 to 10 gal/ton) by recycle. Nearly 70% of the by-products coke plants have some wastewater from this source.

Available monitoring data (including toxic pollutant data) for final cooler wastewaters are from one plant with a relatively high flow of 294 l/kkg (70.5 gallons per ton) of coke produced. These data are shown in Table V-3 for 31 pollutants. Somewhat higher pollutant concentrations might be expected at plants with higher recycle rates and correspondingly lower blowdown flows. Although waste ammonia liquor is the most contaminated cokemaking wastewater, the levels of certain volatile pollutants (e.g., benzene, cyanide, isophorone, and toluene) in final cooler wastewaters exceed those in ammonia liquor. Additional data for mixtures of final cooler wastewater and benzol plant wastwaters are shown in Table V-4.

Light oil recovery (benzol plant) wastewater volumes also vary widely, depending upon the degree of recovery (crude or refined), and whether recirculation is practiced. Although once-through systems generate from 835 to 6,260 l/kkg (200 - 1,500 gal/ton), recirculation is usually practiced which reduces the discharge flows to between 46 and 534 l/kkg (11 to 128 gal/ton). Toxic pollutant concentrations found in benzol plant (light oil recovery) wastewaters are shown in Table V-5. Certain toxic organics (e.g., benzo(a)pyrene, isophorone, parachlorometacresol) common in other coke plant wastewaters were not detected in benzol plant wastewaters. Also, most of the pollutant concentrations observed in benzol plant wastewaters are significantly lower than those in the other cokemaking wastewaters. Notable exceptions are benzene, toluene and xylene, which were found in benzol plant wastewaters at levels 3 to 7 times higher than in other wastewaters. As in the case of final cooler wastewaters, most (over 60%) of the by-product recovery plants have some flow from benzol plant processes.

As noted above, these three sources of wastewater are common to most by-product cokemaking operations. Additional sources include steam condensates from ammonia and phenol recovery units, drip legs, test taps, floor drains and washdowns and runoffs from coke quenching operations. Steam condensates have been measured at 10 to 20% of the wastewater volumes delivered to the recovery units. The other combined "miscellaneous wastewaters" were found at flows from 21 to 350 l/kkg (5 to 84 gallons/ton), depending to a large extent upon the degree of housekeeping and maintenance provided. Some plants have been able to apply practices which minimize flows requiring treatment prior to disposal, while others have chosen not to, and allow such sources to be consumed in quenching operations.

Coke quenching operations for by-product recovery and beehive operations require an applied rate of 500 to 3,750 l/kkg (120 to 900 gal/ton), with an average application rate of 2,100 l/kkg (500 gal/ton). Approximately one-third of the applied flow (170 gal/ton) is evaporated during each quench. The runoffs are collected in a sump and reused for subsequent quenches with no discharge of wastewater to treatment or receiving streams. Thirty-one by-product coke plants dispose of much of their process wastewaters by quenching. The process wastewaters which are most often disposed of in this fashion are final cooler blowdowns and benzol plant wastewaters. In nearly all cases, fresh water is mixed with the wastewaters, but in at least one plant, the quench stations operate using more than 90% contaminated water.

The water application rates required for quenching result from attempts to strike a balance between the need to quench the incandescent coke, and yet leave enough heat in the coke to evaporate water trapped within it. If the water which remains entrapped is primarily contaminated wastewater, many of the contaminants are transferred to the blast furnace, thereby increasing the wastewater pollutant loads at the blast furnace gas washers. Much higher ammonia-N concentrations are found in blast furnace wastewater recirculation systems at furnaces that are fed with coke quenched with dirty water. To further compound the problem of using contaminated wastewater for quenching, studies have indicated increased metal corrosion in and around quench stations which use "dirty water" quenching compared to stations using fresh water makeup only. Particulate emissions from quench towers tested with both contaminated and fresh makeup waters were found to be more than twice as high with dirty water quenching, i.e., 20.4 kilograms (45 pounds) of particulates per quench with dirty water versus 9.5 kilograms (21 pounds) of particulates per quench with clean water. The difference was related to the higher level of dissolved solids in the contaminated makeup water. The use of wastewater treatment systems prior to quenching may not be appropriate, since the high dissolved solids concentrations in waste ammonia liquors are not reduced by conventional treatment means. This dissolved matter is converted to particulates in the atmosphere as water vapor is flashed off. Dirty water quenching is likely to become more limited in the future.

There have not been any significant steps taken toward dry coke quenching in this country, despite the use of this technology in the Soviet Union, Japan, England, France, Germany and Switzerland. New cokemaking operations constructed in the U.S. will most likely include water quenching with total recycle of quench water and fresh water makeup. Although all plants in this country practice quenching with water, overflows from quenching operations were not reported for many plants. Quenching wastewaters from by-product and beehive operations are usually recycled to extinction, leaving no wastewaters requiring further treatment. The quality of wastewaters following its use as quench water is shown in Table V-6 for fresh and contaminated waters at by-product coke quenching operations and in Table V-7 for fresh water quenching at beehive operations.

The remaining wastewater sources identified during plant surveys were found at fewer than half of the cokemaking operations. Fourteen by-product cokemaking plants have barometric condensers to create a vacuum in ammonium sulfate crystallizer systems. This operation generates fairly high volumes of contaminated wastewaters. Once-through flows were reported between 83 and 1710 l/kkg (20 to 410 gal/ton), but some users practice tight recycle of crystallizer wastewaters, reducing blowdown rates to 4 to 42 l/kkg (1 to 10 gal/ton). This wastewater is often discharged without treatment, even though considerable concentrations of cyanides are present. Refer to Table V-8 for monitoring data for barometric condenser wastewaters. Surface condensers, have been installed at some plants to minimize wastewater volume.

Another wastewater source requiring treatment is the discharge from wet desulfurizers, which are used at eleven plants to recover sulfur compounds from coke oven gas. Again, once-through flows are high, up to 900 l/kkg (216 gal/ton), but recycle is often practiced bringing wastewater blowdown rates down to 33 to 125 l/kkg (8 to 30 gal/ton)

In addition to the foregoing basic flows associated with cokemaking and by-product recovery, additional process waters originate from scrubbers used to reduce air pollution emissions. Some of these, notably scrubbers on coal handling, crushing or blending, and coke handling, transfer or screening contribute only minor volumes with easily removable suspended matter as the major pollutant. Other sources generate highly contaminated effluents which require higher levels of treatment; notably, blowdowns from coal drying and preheating operations which are small in volume but contain thousands of mg/l of TSS and high levels of volatile organic compounds. Once-through flows average from 167 to 667 l/kkg (40 to 160 gal/ton), but 95% recycle of such wastewaters provides blowdown volumes of 8 to 33 l/kkg (2 to 8 gal/ton). Scrubbers on larry cars and other charging equipment generate highly contaminated wastewater with blowdowns ranging from 21 to 104 l/kkg (5 to 25 gal/ton). A recent survey conducted by EPA Region V Eastern District Office quantified the pollutant concentrations for a typical larry car scrubber system. Monitoring data are presented in Table V-9.

The largest single volume of wastewater associated with air pollution controls is that from coke pushing operations. Over 8340 l/kkg (2000 gal/ton) can be applied to scrubbing emissions at the pushing side of a coke battery. Recycle of these wastewaters can be used to reduce the volume requiring treatment to 420 l/kkg (100 gal/ton) or less. Data covering two pushing emission control systems are shown in Table V-10. Note that the concentrations of toxic organic pollutants are low when compared with charging emission scrubbers such as the larry car data referred to above.

A summary of average by-product cokemaking process wastewater flows observed during sampling visits and reported in responses to questionnaires is presented in Table V-11. The column headed "Average of Best" represent the average of at least the best 20% of questionnaire respondents. The Agency believes these plants are representative of the industry and that other plants in the subcategory can achieve the BPT model treatment system flow.

The applied flow rates for beehive cokemaking operations were discussed above. The ability to recycle all wastewaters to extinction in the coke quenching process has been demonstrated at beehive cokemaking operations.

After reviewing the net and gross concentrations of the pollutants considered for limitation in the cokemaking subcategory, the Agency concluded the effect of make-up water quality on the various waste streams is minor or negligible. Hence, the effluent limitations and standards were proposed on a gross basis. A detailed review of these data is presented in Section VII.

TABLE V-1

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES STUDY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN EXCESS AMMONIA LIQUOR[1]

						Mixed Flow[2]
	Reference Code	0112	0384A	0272	Average	0432B
	Plant Code	B	C	D	of 3	A
	Sample Point	1	1	1	-	5
	Flow (Gal/Ton)	27.0	32.6	21.6	27.1	82.7[3]
	Suspended Solids	22	496	30	183	13
	Oils & Greases	37	116	148	100	27
	Ammonia (N)	5030	6822	3715	5189	2635
	Sulfide	1320	203	183	569	15
	Thiocyanate	1070	86	128	428	NA
	pH, (Units)	8.5	6.0-7.9	8.7	6.0-8.7	9.6
117	Beryllium	<0.02	<0.04	NA	0	NA
121	Cyanide	97	96	145	113	75.3
191	Phenolic Compounds	1006	1006	708	907	751

NA: Not Analyzed.

(1) All values are in mg/l unless otherwise noted.

(2) Sample contains wastewaters from benzol plant and final cooler blowdown in addition to excess ammonia liquor.

(3) Flow consists of 49.3 GPT ammonia liquor, 24.9 GPT benzol plant wastewaters, and 8.5 GPT final cooler blowdown.

TABLE V-2

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN EXCESS AMMONIA LIQUOR(1)

						Mixed Flow(2)
Reference Code		0868A	0920F	0684F	Average	0464C
Plant Code		003	008	009	of 3	002
Sample Point(s)		C	B	B	-	B
Flow (Gal/Ton)		27.8	32.5	47.0	35.8	35.9(3)
	Suspended Solids	80	44	97	74	14
	Oils & Greases	184	172	83	146	71
	Ammonia (N)	2387	4375	8255	5006	5067
	Sulfide	439	908	976	774	1833
	Thiocyanate	592	659	680	644	1245
	Phenolic Cpds.	626	1172	1715	1171	702
	pH, (Units)	9.6-9.8	8.8-8.9	8.6	8.6-9.8	9.0-9.1
3	Acrylonitrile	ND	3.3	ND	1.1	4.7
4	Benzene	27.2	5.2	3.4	11.9	2.8
20	2-Chloronaphthalene	ND	ND	ND	ND	0.043
21	2,4,6-Trichlorophenol	ND	ND	ND	ND	0.40
22	Parachlorometacresol	ND	ND	0.014	0.005	4.3
23	Chloroform	1.37	0.47	0.066	0.635	<0.003
34	2,4-Dimethylphenol	5.3	<0.01	ND	1.77	83.7
38	Ethylbenzene	0.64	0.11	ND	0.25	0.29
39	Fluoranthene	3.13	1.51	0.21	1.62	0.98
54	Isophorone	ND	<0.01	ND	0	ND
55	Naphthalene	28.9	35.3	27.5	30.6	10.6
57	2-Nitrophenol	ND	ND	0.08	0.027	1.5
60	4,6-Diritro-o-cresol	ND	ND	0.09	0.03	0.97
64	Pentachlorophenol	ND	ND	0.40	0.13	ND
65	Phenol	327	413	120	287	666
(4)	Phthalates, Total	2,30	1.81	0.85	1.65	1.98
72	Benzo(a)anthracene	ND	0.015	ND	0.005	*
73	Benzo(a)pyrene	ND	0.197	0.225	0.206	0.51

TABLE V-2
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN EXCESS AMMONIA LIQUOR(1)
PAGE 2

					Average of 3	Mixed Flow(2)
Reference Code		0868A	0920F	0684F		0464C
Plant Code		003	008	009		002
Sample Point(s)		C	B	B	-	B
Flow (Gal/Ton)		27.8	32.5	47.0	35.8	35.9(3)
76	Chrysene	ND	0.32	0.07	0.13	*
77	Acenaphthylene	6.4	5.7	4.2	5.4	3.2
78	Anthracene	*	*	*	*	*
79	Benzo(ghi)perylene	0.03	ND	ND	0.01	0.003
80	Fluorene	2.5	0.70	0.37	1.19	0.77
81	Phenanthrene	*	*	*	*	*
84	Pyrene	2.6	0.71	0.16	1.16	0.82
86	Toluene	8.9	2.1	0.443	3.8	0.91
130	Xylene	0.01	ND	55	18.3	<0.01
114	Antimony	NA	0.24	0.40	0.32	0.033
115	Arsenic	NA	0.66	0.21	0.43	0.267
117	Beryllium	<0.001	<0.001	NA	0	<0.002
120	Copper	0.017	0.017	0.065	0.033	0.100
121	Cyanides	22.3	28.6	25.9	25.6	21.5
124	Nickel	<0.005	<0.005	NA	0	0.065
125	Selenium	NA	2.6	0.13	1.36	0.457
126	Silver	<0.001	<0.001	<0.02	0	<0.025
128	Zinc	0.13	0.47	NA	0.30	0.241

NA: Not analyzed.
ND: None detected.
* : Compound could not be separated, but is present in sample.

(1) All values are in mg/l unless otherwise noted.
(2) Sample contains wastewaters from final cooler blowdown in addition to excess ammonia liquor.
(3) Flow consists of 29.9 GPT excess ammonia liquor and 6.0 GPT final cooler blowdown.
(4) Value shown is the sum of all values for the following phthalates: 66 Bis-(2-ethylhexyl); 67 Butylbenzyl; 68 Di-n-butyl; 69 Di-n-octyl; 70 Diethyl and 71 Dimethyl phthalate.

TABLE V-3

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN FINAL COOLER BLOWDOWNS(1)

Reference Code		0732A
Plant Code		001
Sample Point(s)		C-A
Flow, (Gal/Ton)		70.5
	Suspended Solids	29
	Oils & Grease	28
	Ammonia (N)	30
	Sulfide	22
	Thiocyanate	52
	Phenolic Compounds	101
	pH, (Units)	7.3
3	Acrylonitrile	1.5
4	Benzene	37.3
35	2,4-Dinitrotoluene	1.87
36	2,6-Dinitrotoluene	0.236
39	Fluoranthene	1.09
54	Isophorone	4.00
55	Naphthalene	39.0
65	Phenol	59.7
(2)	Phthalates, Total	1.44
72	Benzo(a)anthracene	0.107
73	Benzo(a)pyrene	0.080
76	Chrysene	0.053
77	Acenaphthylene	0.323
80	Fluorene	0.156
84	Pyrene	0.080
86	Toluene	17.0
114	Antimony	<0.003
115	Arsenic	0.006
117	Beryllium	<0.002
120	Copper	<0.004
121	Cyanides	188
125	Selenium	<0.005
126	Silver	<0.025
128	Zinc	0.08

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(1) All values are in mg/l unless otherwise noted.

(2) Value shown is the sum of all values for the following phthalates: 66 Bis-(2-ethylhexyl); 67 Butylbenzyl; 68 Di-n-butyl; 64 Di-n-octyl; 70 Diethyl and 71 Dimethyl phthalate.

TABLE V-4

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES STUDY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN FINAL COOLER BLOWDOWNS(1)

	Mixed Flow(2)	Mixed Flow(3)	Average of Two Mixed Samples
Reference Code	0112	0384A	
Plant Code	B	C	-
Sample Point(s)	4-3	3-4	
Flow, (Gal/Ton)	100(4)	448(5)	274 64 FCBD 62 Benzol Plt. 148 Quench Recycle
Suspended Solids	40	(11)(6)	40
Oils & Greases	293	84	189
Ammonia (N)	107	92	100
Sulfide	443	135	289
Thiocyanate	7.4	10	8.7
pH (Units)	8.0	8.5	8.0-8.5
117 Beryllium	<0.02	<0.04	0
121 Cyanides	118	51	84
191 Phenolic Cpds.	178	150	164

---

(1) All values are in mg/l unless otherwise noted.
(2) Sample contains wastewaters from benzol plant in addition to final cooler blowdowns.
(3) Sample contains wastewaters from benzol plant in addition to final cooler blowdowns, and is the runoff to a sump following use as quench water.
(4) Flow consists of 82.5 GPT final cooler blowdown and 17.5 GPT of benzol plant wastewaters.
(5) Flow consists of 45.5 GPT final cooler blowdown and 107 GPT of benzol plant wastewaters and 296 GPT of recycled quench.
(6) Non-representative sample for suspended solids, which were conveyed along the bottom of the sampling sluiceway.

TABLE V-5

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN BENZOL PLANT WASTEWATERS(1)

		0920F(2)	0684F	Average of 2
Reference Code				
Plant Code		008	009	-
Sample Point(s)		D-(A+C)	G-A	
Flow, (Gal/Ton)		23.4	49.7	36.6
	Suspended Solids	95	75	85
	Oils & Greases	38	166	102
	Ammonia (N)	366	187	276
	Sulfide	-	79	40
	Thiocyanate	264	239	252
	Phenolic Compounds	127	455	291
	pH (Units)	7.8	8.4-8.5	7.8-8.5
1	Acenaphthene	0.150	0.005	0.078
3	Acrylonitrile	2.07	1.45	1.76
4	Benzene	74.5	85.5	80.0
34	2,4-Dimethylphenol	5.97	ND	2.78
38	Ethylbenzene	0.654	<0.005	0.33
39	Fluoranthene	0.232	0.95	0.59
55	Naphthalene	5.31	27.5	16.4
64	Pentachlorophenol	ND	1.16	0.58
65	Phenol	75.8	40.0	57.9
(3)	Phthalates, Total	-	12.42	6.21
72	Benzo(a)anthracene	NA	1.20	0.60
76	Chrysene	-	1.49	0.75
77	Acenaphthylene	-	1.19	0.60
78	Anthracene	*	ND	*
80	Fluorene	0.195	0.175	0.185
81	Phenanthrene	*	ND	*
84	Pyrene	-	1.05	0.53
86	Toluene	10.1	11.5	10.8
130	Xylene	ND	145.0	72.5
114	Antimony	-	<0.1	0
115	Arsenic	-	0.055	0.028
117	Beryllium	<0.01	NA	0
118	Cadmium	0.006	<0.01	0.003
119	Chromium	0.005	NA	0.005
120	Copper	-	0.02	0.01
121	Cyanides	-	0.025	0.013
122	Lead	-	<0.05	0
126	Silver	1.89	<0.02	0.95

NA: Not analyzed.
ND: None detected.
- : Calculation resulted in negative value for net concentration, and is equivalent to ND.
* : Compound could not be separated, but is present in sample.

(1) All values are in mg/l unless otherwise noted.
(2) Concentration is calculated by difference from other sampling points.
(3) Value shown is the sum of all values for the following phthalates: 66 Bis-(2-ethylhexyl) 67 Butylbenzyl; 68 Di-n-butyl; 69 Di-n-octyl, 70-Diethyl and 71-Dimethylphthalate.

TABLE V-6

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES STUDY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATION OF POLLUTANTS IN WASTEWATERS FROM QUENCHING(1)

	Fresh Water Make-up	Contaminated Water(2) Make-up
Reference Code	0384A	0384A
Plant Code	C	C
Sample Point(s)	5-4	3-4
Flow (Gal/Ton)	498	448(3)
Suspended Solids	703	(11)(4)
Oils & Greases	9.6	84
Ammonia (N)	1.94	92
Sulfide	<0.02	135
Thiocyanate	<3	10
pH (Units)	7.6	8.5
117 Beryllium	<0.04	<0.04
121 Cyanides	4.0	51
191 Phenolic Cpds.	1.46	150

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(1) All values are in mg/l unless otherwise noted.

(2) Sample contains wastewaters from benzol plant and from final cooler blowdowns.

(3) Flow consists of 45.4 GPT final cooler discharge, 107 GPT benzol plant wastewater, and 296 GPT of recycled quenchwaters.

(4) Non-representative sample for suspended solids, which were conveyed along the bottom of the sampling sluiceway.

TABLE V-7

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES STUDY
BEEHIVE COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN WASTEWATERS FROM QUENCHING(1)

	Plant Code	E	F	G	Average of 3
	Sample Point(s)	3-5	1-(2+5)	1-(2+3+4)	
	Flow (Gal/Ton)	490	490	123	368
	Suspended Solids	165	29	713	302
	Oils & Greases	<1	<1	3.7	1.2
	Ammonia (N)	0.27	-	-	0.09
	Sulfide	<0.02	<0.02	<0.02	0
	Thiocyanate	<3	<3	-	0
	pH (Units)	7.3	7.3	7.0-7.3	7.0-7.3
117	Beryllium	<0.02	<0.02	<0.02	0
121	Cyanide	0.002	<0.002	<0.002	0.001
123	Mercury	0.0031	-	0.0026	0.0019
191	Phenolic Compounds	0.011	<0.01	<0.002	0.004

- : Calculation resulted in negative value for net concentrations, and is equivalent to ND.

(1) All values are in mg/l unless otherwise noted.

TABLE V-8

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELIENS STUDY
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN CRYSTALLIZER BAROMETRIC CONDENSER WASTEWATER (1)

Reference Code		0432B
Plant Code		A
Sample Point(s)		4-3
Flow, (Gal/Ton)		56.6
	Suspended Solids	35
	Oils & Greases	8.5
	Ammonia (N)	0.27
	pH (Units)	8.7
117	Beryllium	<0.02
121	Cyanide	138
191	Phenolic Compounds	2.72

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(1) All values are in mg/l unless otherwise noted.

TABLE V-9

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANT
TOXIC POLLUTANT SURVEY - EPA REGION V EDO
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS(1) IN LARRY CAR SCRUBBER BLOWDOWNS

Reference Code		0584B
Flow (Gal/Ton)		24.2
	Suspended Solids	9218
	Oils & Greases	17.5
	Ammonia (N)	9.42
	Sulfide	<0.25
	Thiocyanate	<0.50
	Phenolic Cpds.	7.54
	pH (Units)	4.0
4	Benzene	0.050
34	2,4-Dimethylphenol	0.040
38	Ethylbenzene	<0.010
39	Fluoranthene	0.68
55	Naphthalene	0.27
65	Phenol	1.72
68	Di-n-butyl phthalate	<0.010
72	Benzo(a)anthracene*	<0.64
73	Benzo(a)pyrene	0.31
75	Benzo(k)fluoranthene	0.40
76	Chrysene*	<0.64
77	Acenaphthylene	0.45
78	Anthracene*	<1.04
81	Phenanthrene*	<1.04
82	Dibenzo(a,h)anthracene	0.11
83	Indeno(1,2,3-dc)pyrene	0.18
84	Pyrene	0.55

TABLE V-9
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANT
TOXIC POLLUTANT SURVEY - EPA REGION V EDO
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN
LARRY CAR SCRUBBER BLOWDOWNS(1)
PAGE 2

114	Antimony	<0.001
115	Arsenic	0.244
117	Beryllium	<0.010
118	Cadmium	0.010
119	Chromium	0.020
120	Copper	0.010
121	Cyanides	0.50
122	Lead	0.050
123	Mercury	<0.001
124	Nickel	0.036
125	Selenium	<0.005
126	Silver	<0.006
127	Thallium	<0.05
128	Zinc	0.09

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(1) All values are in mg/l unless otherwise noted.
* Compound could not be separated, but is present in sample.

TABLE V-10

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY - EPA REGION V EDO
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS
IN PUSHING EMISSION CONTROL SYSTEM BLOWDOWNS(1)

		One-Spot Push & Quench Car	Stationary Emission Control System
Reference Code		0684F	0320
Flow (Gal/Ton)		70.0	43.5
	Suspended Solids	2260	2032
	Oils & Greases	<1	2
	Ammonia (N)	2.15	0.51
	Sulfide	<0.16	<0.25
	Thiocyanate	0.10	<0.50
	Phenolic Cpds.	0.381	0.33
	pH (Units)	6.5	4.6-7.1
4	Benzene	<0.010	-
23	Chloroform	<0.010	ND
24	2-Chlorophenol	ND	<0.010
34	2,4-Dimethylphenol	ND	0.020
37	1,2-Diphenylhydrazine	<0.010	ND
39	Fluoranthene	0.011	<0.010
44	Methylene Chloride	0.017	-
55	Naphthalene	<0.010	<0.010
65	Phenol	<0.010	0.070
66	Bis(2-ethylhexyl) phthalate	<0.010	-
67	Butyl benzyl phthalate	<0.010	ND
68	Di-n-butyl phthalate	<0.010	ND
69	Di-n-octyl phthalate	<0.010	ND
70	Diethyl phthalate	<0.010	ND
71	Dimethyl phthalate	<0.010	ND
72	Benzo(a)anthracene*	<0.010	<0.010
73	Benzo(a)pyrene	<0.010	ND
75	Benzo(k)fluoranthene	<0.010	ND
76	Chrysene*	<0.010	<0.010
77	Acenaphthylene	<0.010	<0.010
78	Anthracene*	<0.010	0.010
79	Benzo(ghi)perylene	<0.010	ND
80	Fluorene	<0.010	<0.010
81	Phenanthrene*	<0.010	0.010
82	Dibenzo(a,h)anthracene	<0.010	ND
83	Indeno(1,2,3-cd)pyrene	<0.010	ND
84	Pyrene	0.013	<0.010

TABLE V-10
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY - EPA REGION V EDO
BY-PRODUCT COKEMAKING OPERATIONS
NET CONCENTRATIONS OF POLLUTANTS IN PUSHING EMISSION CONTROL SYSTEM BLOWDOWNS(1)
PAGE 2

		One-Spot Push & Quench Car	Stationary Emission Control System
114	Antimony	NA	<0.001
115	Arsenic	NA	0.017
117	Beryllium	0.002	<0.010
118	Cadmium	0.003	<0.010
119	Chromium	0.147	0.010
120	Copper	0.238	0.020
121	Cyanides	0.235	0.015
122	Lead	0.09	0.010
123	Mercury	-	<0.001
124	Nickel	0.178	ND
125	Selenium	NA	0.010
126	Silver	<0.003	<0.006
127	Thallium	NA	<0.050
128	Zinc	0.164	0.060

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(1) All values are in mg/l unless otherwise noted.

- : Calculation of net concentration yields negative number, due to higher level in make-up water.
* : Compound could not be separated, but is present in sample.
ND: None detected.
NA: Not analyzed.

TABLE V-11

SUMMARY OF PROCESS WASTEWATER FLOW RATES
BY-PRODUCT COKEMAKING OPERATIONS

(All Flows are Listed in Gallons of Wastewater per Ton of Coke Produced - GPT)

Wastewater Sources	Flow Data Source					
	Plant Sampling Visits		Questionnaire Responses			
	Average of All		Average of All		Average of All	
	I&S	Merc.	I&S	Merc.	I&S	Merc.
Excess Ammonia Liquor	36(6)	33(3)	47(40)	57(17)	32(18)	36(9)
Final Cooler Blowdown	46(3)	38(2)	37(26)	68(8)	10(16)	12(3)
Benzol Plant Wastewater	45(5)	39(2)	54(31)	66(9)	25(17)	28(6)
Miscellaneous Process Wastewaters	33(2)	21(2)	43(20)	68(5)	20(13)	24(3)
Steam Condensate	12(6)	8(2)	19(29)	15(8)	13(19)	15(8)
Barometric Condenser Blowdown	57(1)*	-	109(13)**	144(1)*	9(4)	-
Wet Desulfurizer Wastewater	-	17(2)	34(9)	18(3)	34(9)	18(3)
Dilution Water (Biotreatment only)	50(3)	-	61(7)	42(2)	46(5)	42(2)
Indirect Ammonia Recovery (Additional Flow)	-	-	68(2)	55(4)	68(2)	55(4)
Air Pollution Control Blowdowns:						
Preheater and Dryers	-	-	66(3)	58(3)	9(1)	18(1)
Charging Operations	7(2)	-	6(4)	130(1)	4(2)	130(1)

TABLE V-11
SUMMARY OF PROCESS WASTEWATER FLOW RATES
BY-PRODUCT COKEMAKING OPERATIONS
PAGE 2

Wastewater Sources	Flow Data Source					
	Plant Sampling Visits		Questionnaire Responses			
	Average of All		Average of All		Average of All	
	I&S	Merc.	I&S	Merc.	I&S	Merc.
Pushing Operations	141(3)	19(1)	279(7)	49(3)	42(3)	41(2)
Total Applied Flow	140(6)	122(3)	177(41)	213(16)	140(38)	154(15)
Total Effluent Flow	165(6)	127(3)	199(41)	238(16)	161(31)	171(15)
Total Effluent Flow for Biotreatment Systems only	171(3)	-	205(8)	232(3)	205(8)	232(3)

( ): Numbers in parenthesis indicate the number of plants included in the stated average calculation.
- : Indicates there are no plants within the subgroup which have reported flows from the given source.
* : Indicates flow from a once-through operation.
** : Average includes flows which may or may not be blowdown flows. Questionnaire responses were not specific enough to positively determine which flow procedure is used by the plant.

COKEMAKING SUBCATEGORY

SECTION VI

WASTEWATER POLLUTANTS

Introduction

The originally promulgated regulation established limitations for by-product cokemaking operations for ammonia-n, cyanide, oil and grease, phenols (4-AAP), suspended solids, and pH. The Agency found other pollutants in the wastewaters in significant quantities (e.g., chlorides, sulfates, sulfides, dissolved solids), but did not establish specific limitations for those pollutants.

Conventional Pollutants

In the originally promulgated regulation, the Agency established limitations for three conventional pollutants (TSS, oil and grease, and pH). Suspended solids originate, in part, as particles of condensed tars, naphthalene crystals and bits of fine coal or coke which are carried out with coke oven gas, and then subsequently trapped in flushing liquor. Another source of suspended solids is the lime addition at fixed ammonia distillation columns. Unreacted lime is the major component of the suspended solids in by-product coke plant wastewaters, while coke fines make up the bulk of suspended solids in beehive wastewaters. Biological treatment of cokemaking wastewaters also generates suspended solids.

Oils and greases are among the numerous products formed during the destructive distillation of coal, along with the other organic pollutants described below. These oils and greases are not the typical lubricating oils found in the wastewaters from other steel industry operations, but are organic compounds which are extracted by the solvents used in the analytical procedure for measurement of oil and grease in wastewaters.

The limitations regulate wastewater pH routinely in all subcategories, principally because of the environmentally detrimental impacts which occur due to extremes in pH. Untreated by-product cokemaking wastewaters are typically alkaline due to high levels of ammonia in solution. The pH is raised even further (to 10-12 standard units) for ammonia distillation, thus the wastewaters require neutralization prior to discharge.

Toxic Pollutants

Total cyanide was limited in the prior regulation. For this regulation, the Agency employed sophisticated analytical techniques to evaluate the presence, absence, or magnitude of 115 organic and 15 nonorganic toxic pollutants in cokemaking process wastewaters.

Most of the toxic pollutants found in by-product cokemaking wastewaters are products of the destructive distillation of coal. Additional sampling, specifically designed to provide data for the toxic pollutants, confirmed the presence of 40 toxic organic and 11 toxic metal pollutants. Refer to Table VI-1 for a summary of all toxic pollutants found in cokemaking wastewaters. Since the original limitations required "no discharge of process wastewater pollutants" from beehive operations, the Agency did not include those operations in the toxic pollutant survey. The data presented for beehive cokemaking were gathered during the original guidelines study.

Sixteen of the toxic pollutants shown in Table VI-1 were observed at relatively low concentrations (0.01 to 0.02 mg/l) at only one coke plant. The overall list was shortened by deleting such pollutants, primarily because pollutants found at such low levels are generally not treatable to lower levels. The remaining 35 toxics appeared to be more characteristic of the raw wastewaters from by-product cokemaking operations.

Based upon their presence in untreated wastewaters from cokemaking operations, the Agency considered establishing limitations for the following 29 organic and 6 nonorganic pollutants:

TOXIC ORGANIC POLLUTANTS

Acrylonitrile
Benzene
2,4,6-Trichlorophenol
Parachlorometacresol
Chloroform
2,4-Dimethylphenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Ethylbenzene
Fluoranthene
Isophorone
Naphthalene
4,6-Dinitro-o-cresol
Pentachlorophenol
Phenol
Bis(2-ethylhexyl)phthalate
Butyl benzyl phthalate
Di-n-butyl phthalate
Di-n-octyl phthalate
Diethyl phthalate
Dimethyl phthalate
Benzo(a)anthracene
Benzo(a)pyrene
Chrysene
Acenaphthylene
Pyrene
Fluorene
Toluene
Xylene

TOXIC METAL POLLUTANTS AND CYANIDE

Antimony
Arsenic
Cyanide
Selenium
Silver
Zinc

The Agency found methylene chloride at high levels in all of the wastewater samples from one plant. The Agency decided not to establish limitations for that pollutant since its detection most likely resulted from its use as a cleaning solvent for cleaning sampling devices and laboratory glassware used for sampling and analysis of certain toxic organic pollutants. While the Agency believes the presence of phthalate compounds in wastewaters from many steel industry wastewaters is due to leaching of these compounds from the tubing use with automatic sampling equipment, the Agency believes that certain phthalate compounds are contributed by cokemaking operations.

The Agency found six individual phthalates (refer to Table VI-2) at varying levels at the five coke plants, with no discernible pattern, except that bis(2-ethylhexyl) and di-n-butyl phthalate were most often found, and diethyl and dimethyl phthalate the least prevalent. But for a given plant, (e.g., 009) diethyl or dimethyl phthalate could be found at higher concentrations than the more common ones. As discussed later in this report, removal of other toxic organics that are limited should insure control of phthalates.

Other Pollutants

Ammonia-N, is universally found at extremely high levels in wastewaters from by-product recovery cokemaking operations. The originally promulgated BPT regulation contained ammonia-N limitations, as does this regulation. Ammonia is found at high concentrations in raw by-product recovery cokemaking wastewaters, is acutely toxic to aquatic life at relatively low levels, and exerts a significant oxygen demand in receiving streams.

The prior regulation also contained limitations and standards for phenols (4AAP), which are found at high levels in cokemaking wastewaters.

The Agency considered establishing limitations for two additional nontoxic pollutants: thiocyanates and sulfides. Thiocyanates are present in cokemaking wastewaters, and have a potential for breaking down into cyanides and sulfides under certain conditions. Sampling data obtained during coke plant visits provides a basis for establishing limitations for thiocyanates. However, long term data for existing biological treatment facilities also indicate that thiocyanate is adequately controlled by the model treatment systems considered by the Agency. The same is true of sulfides. Accordingly, the Agency has not promulgated limitations for these pollutants.

Additional wastewater characteristics and pollutants studied in by-product cokemaking operations include acidity/alkalinity, aluminum, barium, boron, calcium, carbon, chloride, cobalt, hardness, iron, magnesium, manganese, molybdenum, nitrate, potassium, silica, sodium, solids (dissolved and volatile), sulfate, tin, titanium, vanadium and ytterbium. Data for these pollutants are available in a supplement to this report. Based upon low levels of these pollutants found in cokemaking wastewaters, or their nontoxic characteristics, the Agency has not promulgated limitations and standards for them.

Selected Wastewater Pollutants

The Agency has promulgated limitations and standards for those pollutants which it considers to be most representative of the pollutants found in cokemaking wastewaters. These pollutants are shown in Table VI-3. These include the pollutants which were included in the original BPT limitations, and for by-product cokemaking, three additional toxic organic pollutants.

Because of the high costs of monitoring for toxic organic pollutants, the Agency reviewed analytical data to determine if certain pollutants can serve as "indicators" for groups of other pollutants found in cokemaking wastewaters. The Agency concludes that certain pollutants can be used as "indicators" for other pollutants. Six volatile, six acid extractable and 17 base/neutral toxic organic pollutants were found in cokemaking wastewaters. To regulate these 29 pollutants, benzene was selected to indicate the presence of volatile toxic organic pollutants; phenols (4AAP) to indicate the presence of acid extractable toxic organic pollutants; and naphthalene and benzo(a)pyrene to indicate the presence of base/neutral compounds. Available data from EPA surveys at plants 0868A and 0684F indicate that effective treatment for these indicator pollutants results in comparable reductions or the elimination of the remaining 25 toxic organic pollutants. Additional information on the use of "indicator" pollutants is found in Volume I.

TABLE VI-1

TOXIC POLLUTANTS KNOWN TO BE PRESENT COKEMAKING SUBCATEGORY

By-product Cokemaking Operations

Toxic Pollutant Number	Pollutant	Toxic Pollutant Number	Pollutant
1	Acenaphthene	72	Benzo(a)anthracene
3	Acrylonitrile	73	Benzo(a)pyrene
4	Benzene	75	benzo(k)fluoranthene
20	2-Chloronaphthalene	76	Chrysene
21	2,4,6-Trichlorophenol	77	Acenaphthylene
22	Parachlorometacresol	78	Anthracene
23	Chloroform	79	Benzo(ghi)perylene
24	2-Chlorophenol	80	Fluorene
34	2,4-Dimethylphenol	81	Phenanthrene
35	2,4-Dinitrotoluene	82	Dibenzo(a,h)anthrancene
36	2,6-Dinitrotoluene	83	Indeno(1,2,3-cd)pyrene
38	Ethylbenzene	84	Pyrene
39	Fluoranthene	86	Toluene
44	Methylene Chloride	114	Antimony
54	Isophorone	115	Arsenic
55	Naphthalene	118	Cadmium
57	2-Nitrophenol	119	Chromium
60	4,6-Dinitro-o-cresol	120	Copper
64	Pentachlorophenol	121	Cyanide
65	Phenol	122	Lead
66	Bis-(2-ethylhexyl)phthalate	124	Nickel
67	Butyl Benzyl Phthalate	125	Selenium
68	Di-n-butyl Phthalate	126	Silver
69	Di-n-octyl Phthalate	128	Zinc
70	Diethyl Phthalate	130	Xylene
71	Dimethyl Phthalate		

Beehive Cokemaking Operations

121	Cyanide

TABLE VI-2

PHTHALATES FOUND IN BY-PRODUCT COKEMAKING SAMPLES

Plant Code	Sample No.	Sample Source	Sample Type	#66 Bis (2-ethylhexyl) Phthalate	#67 Butyl Benzyl Phthalate	#68 Di-n-butyl Phthalate	#69 Di-n-octyl Phthalate	#70 Diethyl Phthalate	#71 Dimethyl Phthalate	pH	Temp °F
001	A	F	M	<0.007	<0.007	0.004	0.003	ND	ND	7.2	40
	B	F	M	<0.063	<0.003	<0.017	0.004	ND	1.23	7.2	41
	C	R	M	ND	0.080	0.067	0.080	ND	1.23	7.3	81
	D	R	A	0.122	0.117	ND	ND	0.143	0.307	7.6	67
002	A	F	M	ND	0.01	0.060	ND	ND	0.950	7.9	73
	B	R	M	0.152	ND	1.713	0.115	ND	ND	9.0	122
	C	I	M	3.27	0.993	0.130	0.008	ND	0.007	9.0	115
	D	E	M	0.183	0.600	1.080	0.007	ND	ND	8.9	101
003	A	F	M	<0.031	<0.003	<0.003	<0.010	ND	ND	6.3	60
	B	F	M	<0.121	<0.003	<0.003	0.005	ND	ND	7.0	54
	C	R	M	1.81	0.127	ND	0.036	ND	ND	9.7	137
	D	I	A	13.370	2.933	4.013	0.117	ND	ND	11.3	147
	E	E	A	0.026	<0.046	0.019	0.083	ND	0.018	7.4	69
	F	E	A	<0.041	<0.007	<0.012	0.004	ND	ND	7.2	78
	G	F	M	<0.011	<0.003	<0.003	ND	ND	ND	7.7	52
	P	E	M	0.118	0.010	<0.010	<0.010	<0.010	ND	7.2	64
008	A	F	M	0.013	ND	ND	ND	ND	ND	7.6	88
	B	R	M	0.977	0.143	0.670	<0.020	ND	ND	8.8	154
	C	R	M	4.600	0.510	3.463	4.333	ND	ND	10.6	200
	D	I	M	0.488	0.200	0.283	0.263	0.220	2.503	9.5	143
	E	E	A	1.669	<0.003	0.282	1.567	0.010	0.006	7.6	85
009	A	R	M	<0.010	ND	ND	ND	ND	ND	7.7	79
	B	I	M	0.185	ND	0.155	ND	0.142	0.370	8.6	142
	C	I	M	0.750	ND	0.250	ND	0.650	3.500	8.7	121
	D	I	M	0.450	ND	0.145	ND	0.457	2.850	8.7	119
	E	I	M	<0.010	<0.010	<0.010	ND	<0.005	<0.005	8.7	115
	F	E	M	<0.010	ND	0.010	ND	<0.005	ND	9.0	198
	G	R	M	ND	ND	2.913	ND	3.250	6.265	8.5	106
	H	I	M	0.008	ND	0.105	ND	ND	0.279	9.8	95
	I	I	M	0.013	ND	0.084	ND	0.100	<0.022	9.7	95
	J	E	M	0.194	ND	<0.005	0.135	<0.005	<0.005	9.9	92

Key to Sample Source
- F - Fresh Water Makeup (River, lake, or city water)
- R - Raw Wastewater - before treatment
- I - Intermediate Wastewater - partially treated
- E - Treated Effluent

Key to Sample Type:
- M - Manually Collected
- A - Automatically Collected

TABLE VI-3

SELECTED WASTEWATER POLLUTANTS COKEMAKING SUBCATEGORY

A. By-Product Recovery Processes:

Pollutant		Regulated in the Originally Promulgated BPT Level	Selected For Regulation at BAT
	Suspended Solids	X	-
	Oil and Grease	X	-
	Ammonia-N	X	X
	pH	X	-
4	Benzene		X
55	Naphthalene		X
73	Benzo(a)pyrene		X
121	Cyanides, Total	X	X
191	Phenols (4-AAP)	X	X

	BPT	BAT
B. Beehive Process	No Discharge	No Discharge

COKEMAKING SUBCATEGORY

SECTION VII

CONTROL AND TREATMENT TECHNOLOGY

Introduction

A brief summary of the wastewater treatment practices used at all twelve plants visited during this study demonstrates the different approaches to treatment of cokemaking wastewaters. A summary of the technology used within the entire subcategory is also presented. Included are descriptions of the control and treatment technology applied to cokemaking wastewaters and more detailed discussions of technologies used to treat or control specific pollutants.

Summary of Treatment Practices Currently Employed

Wastewater treatment at beehive coke plants is relatively simple, since the only waste flow requiring control is excess water applied during coke quenching. Treatment consists of one or more sedimentation basins to recover the coke fines, which are then returned to the coking process. Water which overflows the basins is recycled to extinction as quench water, with the result that no wastewater is discharged.

For by-product coke plants, many factors influence the choice of wastewater control and treatment alternatives. The many recovery practices reported in Section III are indicative of the possible combinations found in this subcategory. Similarly, the wastewater control and treatment techniques practiced at operating coke plants demonstrate variations unique to this subcategory, yet the best of these tend to achieve similar quality effluent loads. These treatment systems include physical/chemical controls, biological treatment, or combinations thereof. Some operators provide complete treatment facilities while others provide only limited pretreatment before discharging their wastewaters to POTWs. These latter discharges, although usually lower in flow, contain considerably higher levels of pollutants than do the direct effluent discharges. Zero discharge is achieved at sixteen by-product coke plants through disposal of wastewaters in quenching operations or through oxidative incineration. Both of these practices have limited potential for widespread application because of the impact on air quality.

A summary of the control and treatment technology currently practiced at by-product cokemaking operations follows:

1. By-Product Recovery

   The by-product recovery system itself controls the level of pollutants discharged since the by-products recovered would

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otherwise be part of the untreated wastewater load if excess ammonia liquor was discharged untreated. Recoveries practiced include:

a. Crude coal tar - coal tar from the flushing liquor and primary coolers is collected for resale or further processing on or off-site. Crude coal tar is recovered at all by-product coke plants in tar decanters.

b. Crude light oils - light oils are scrubbed from the coke oven gas, recovered for resale, reuse as a solvent for phenolics, or for further refining on or off-site.

c. Ammonia and ammonium compounds - free ammonia is steam stripped from excess ammonia liquors at most plants. Of those plants with ammonia stills, about half also recover fixed ammonia by elevating the pH of the wastewaters with lime slurry or caustic soda solutions. The liberated ammonia is directed into the coke oven gas and removed with ammonia contained in the gas with sprays of sulfuric or phosphoric acid in an absorber (semi-direct recovery, practiced at 46 plants), or by scrubbing ammonia from gas with fresh water, which is recirculated to produce concentrated ammonium hydroxide (indirect recovery, practiced at 6 plants).

d. Phenol, phenolates and carbolates - between one-third and one-half of operating coke plants practice dephenolization, either by vapor recirculation or liquid/liquid extraction with suitable solvents. In vapor recirculation, the steam leaving the free leg of the ammonia still is scrubbed with dilute caustic soda to form sodium phenolate. This steam recirculates to the ammonia stills for further treatment and recovery. In solvent extraction, the benzol, light oil, or other suitable solvent extracts phenolic compounds from the wastewater. The phenolized solvent is separated and extracted with caustic. Again, sodium phenolates separate out, and the dephenolized solvent is reused in the recovery system.

e. Sulfur and sulfur compounds - eight of the larger coke plants, representing 34% of the coke production capacity in the United States, have desulfurization systems to clean coke oven gas for subsequent reuse and to recover elemental sulfur or sulfur compounds, e.g., ammonium sulfate. Techniques developed include iron oxide boxes using Fe_2O_3 on wood shavings; absorption and desorption with soda ash; Wilputte vacuum carbonate system; Seaboard actified solution system; Claus sulfur recovery systems; and a Takahax absorption/Hirohax sulfur recovery system.

f. Naphthalene - This compound is recovered at about 70 percent of the by-product coke plants. Crystals of naphthalene condensed in the final cooler are recovered from the recirculating final cooler wastewater by skimming, filtration or centrifugation. At most plants, naphthalene crystals which solidify below 74°C (165°F) are recovered. However, at one plant, naphthalene which crystallizes between 74C° and 79C° (165° to 174°F) is recovered; and, at two plants naphthalenes solidifying above or below 74°C (165°F), are recovered separately.

g. Other by-products - recovery of additional by-products is normally related to the further refinement of products recovered above in cruder mixtures, or in alternative approaches to the basic recovery techniques which lead to other forms. For example, instead of recovering ammonia as a sulfate, phosphate, or hydroxide, one plant is designed to convert ammonia into anhydrous ammonia, readily usable as fertilizer or for other chemical processes. Specialized recoveries at that same plant include cresols, cresylic acid, and picolines.

2. Initial Treatment Practices

Once these various levels of by-product recovery are accomplished, contaminated wastewaters remain which require treatment before discharge. The general practice is described below:

a. Recovery of free ammonia from excess ammonia liquor only. This step is considered to be by-product recovery, and is not included in pollution control costs because of its use irrespective of water pollution control requirements.

b. Dephenolization of weak ammonia liquor, benzol plant wastes, and final cooler blowdowns. As in the case of free ammonia stills, this step is considered to be by-product recovery, and is not included in costing of pollution control systems. Where dephenolizers exist at plants with biological treatment systems, they are usually not operated because of the weak market for recovered products and the high efficiency of phenol removal in biological treatment systems.

c. Sedimentation of dephenolized wastes, miscellaneous wastewaters and once-through crystallizer wastewaters, if any, in a settling pond.

d. Recycle of coke quenching wastewaters to extinction with no runoffs. Makeup to the quench system is fresh water only, or fresh water plus air pollution emission control scrubber blowdowns, if any.

3. Biological Treatment

a. Assuming the above starting point, the first additional step is the addition of a fixed leg to the ammonia still, with provision for adding a lime slurry or caustic soda solution and additional steam. This step effectively strips more ammonia from wastewaters. The resulting high pH wastewaters are again neutralized with acid. At a few bio-oxidation treatment plants, the stripping of fixed ammonia is not practiced and instead a two or three to one dilution with fresh water is used to bring the ammonia concentration down to levels which will not inhibit biological activity. However, this practice results in excessive flows and higher pollutant loads in plant effluents.

b. A single stage activated sludge bio-oxidation system is provided to treat neutralized still wastes. Dephenolizers are often abandoned at this point, since biological treatment can control phenolic compounds effectively. Aeration is provided by mechanical agitation or through the use of large blowers.

c. Advanced bio-oxidation systems include a second stage of biological treatment, or provide for extended oxidation in one stage. The activated sludge in the two stage system may be collected and recycled separately at each stage, or collected after the second stage and recycled to the first aeration basin as practiced at plant 003. The effluents from these multi-stage biological reactors are further treated by sedimentation in a clarifier and, where necessary, pH adjustment is made. A possible sequence involves phenol removal in the first of three stages, cyanide and ammonia oxidation to nitrites and nitrates in a second stage, then denitrification in a final stage prior to aeration and discharge. Systems observed during the field surveys include single stage and two stage bio-oxidation reactors. All have varying degrees of dilution water, although several operate without dilution for months at a time. Also, a noncontact cooling system has been installed at one plant to control temperature, a critical factor in treatment plant operations. As a result, dilution water has been essentially eliminated at this plant.

As an alternate to the above systems, a single stage activated sludge system can be operated with high sludge age to produce comparable effluent quality. This alternative would not require any major capital modifications to several of the biological systems currently installed in the industry. However, changes in operating practice would be required.

d. A system which adds powdered activated carbon to a single stage bio-oxidation system is currently being tested to determine the degree of effluent reduction attainable. Benefits are anticipated in improved toxic organic pollutant and suspended solids removal; elimination of color from plant effluents; enhanced oxidation and nitrification; and, increased stability under shock loads.

e. A final polish by filtration provides significant improvement in total suspended solids removal. Deep bed, mixed media pressure filter systems are demonstrated in this application.

4. Physical/Chemical Treatment

a Assuming the level of treatment described in Paragraph 2 with a dephenolizer, the first level of additional technology includes a fixed leg on the ammonia still with provisions for adding a lime slurry or caustic soda solution and additional steam to strip fixed ammonia from the wastewater. Since a high pH results from this treatment, neutralization with acid must be provided before the treated wastes are discharged. Miscellaneous process wastes are sometimes rerouted to pass through both stills and the dephenolizer.

The addition of a fixed ammonia still to the operation of a well designed and operated dephenolizer can produce effluents of sufficient quality to achieve the BPT limitations.

b. At this point, several options are available for those plants which do not have biological treatment systems. One potential route for plants discharging as point sources is toward adsorption of organics on activated carbon. Before this can be accomplished at a reasonable cost, certain preliminary steps must be carried out as follows:

(1) Flows must be minimized wherever possible. Barometric condensers on crystallizers should be recycled, with 4-6% blowdown to treatment. Final cooler recycle loops should be tightened, and miscellaneous wastewaters should be reduced to minimum flow through prevention of leaks and spills.

(2) The wastewaters from the settling pond or sedimentation unit are filtered to remove the suspended solids and any tars or floating material which may remain, and are then passed through activated carbon columns. The resulting effluent is discharged. Filtration is accomplished most effectively by deep bed, mixed media pressure units, although other filtration alternatives are available.

c. An alternative preliminary treatment sequence prior to adsorption on carbon would provide aggressive oxidation using chemicals such as chlorine, chlorine dioxide, sodium hypochlorite, ozone, or peroxides to destroy organic pollutants, ammonia and cyanides. The acid addition in step 4(a) above would be relocated. A typical sequence using chlorine would include aeration; aggressive oxidation at high pH (alkaline chlorination); neutralization, using the relocated acid addition equipment from above; breakpoint chlorination; suspended solids removal by sedimentation or filtration; and a final polish by passing the wastewater through activated carbon columns.

d. Plants which discharge wastewaters to publicly-owned treatment works currently practice an intermediate level of treatment. For example, one plant visited during this survey has aggressive oxidation with chlorine to provide batch treatment of excess ammonia liquor prior to discharge. Treatment is carried out only to the degree that the wastewater is acceptable to the regional sanitary authority. Most plants discharging to POTWs, including the one mentioned above, do not provide sufficient pretreatment to prevent discharge of pollutants which interfere with, pass through, or are otherwise incompatible with POTW operations.

5. Incineration/Evaporation

a. Another alternative approach to coke plant wastewater treatment and disposal has been practiced at at least two plants, and was planned for a third plant. All of the wastewaters from the coke plant are distilled and incinerated in controlled combustion systems. Coke oven gas and crude coal tar are the only by-products recovered, and no wastewaters are discharged to receiving streams or to sanitary authorities. The system is viable only where the impact on air pollution can be tolerated, and therefore has limited potential for widespread application.

b. Zero discharge of pollutants from by-product cokemaking operations is achieved at some plants by disposing of the process wastewaters in coke quenching. An adverse impact on air pollution occurs as a result so this alternative is expected to gradually decline as a solution to the problem of wastewater disposal. The nature and magnitude of pollutant emissions from quenching operations have been the subject of extensive study both here and abroad. Tests were conducted comparing emissions from plants using 100% fresh water make-up with those from plants with treated and/or untreated process wastewaters for make-up. At least one researcher conducted tests on the same quench stations using fresh and contaminated make-ups while maintaining other conditions as constant as possible. Researchers have concluded that a typical "dirty water" quench station releases more than twice as much particulates; four times as much benzene-soluble organics; more than twice as much benzo(a)pyrene; and, nearly nine times as much benzene to the surrounding atmosphere than do the same operation using "clean water" for make-up.

c. Since by-product coke plants must continuously dispose of or otherwise eliminate water originally locked up as moisture in coals, the only likely approach to zero discharge from coke plants would be to require treatment of process wastewaters to an extent where their use for coke or slag quenching would not affect air quality. This level of treatment would approximate the more advanced stages of biological or physical/chemical systems described above as applicable to point source dischargers. The critical pollutant mitigating against the use of well-treated wastewaters for quenching is dissolved solids, since such solids become airborne particulate as the water evaporates. Since the capital and energy requirements for removing dissolved solids from coke plant wastewaters are high, it does not appear likely that dissolved solids controls will be implemented at any plants.

Control and Treatment Technologies for BPT

Two treatment alternatives were identified as model BPT treatment technologies for the prior regulation. One is based upon physical/chemical and biological treatment, while the other included only physical/chemical controls. The physical/chemical system includes the by-product recovery operations noted in item 1 above and the following wastewater treatment operations: fixed ammonia removal; dephenolization; pH control; and, sedimentation. The biological alternative does not include dephenolization, but does include aeration equipment, biological oxidation basins and associated clarifiers for suspended solids control.

Although the BPT limitations can be achieved with either alternative noted above, the Agency has used only the biological alternative as a model BPT treatment system for this regulation to be consistent with the selected BAT model treatment system.

Control and Treatment Technologies for BAT, PSES, PSNS and NSPS

Of the various control and treatment options available for advanced treatment of by-product cokemaking wastewaters, the Agency considered the following model treatment system to achieve the promulgated limitations and standards. The model system incorporates the following treatment steps.

The first step involves minimizing process wastewater flows. Barometric condenser or crystallizer wastewaters are recycled with a minor blowdown (4%) to treatment. Air pollution emission control scrubber loops are recycled at high rates. Blowdowns from preheating and charging are treated in the BPT system, while blowdowns from coke-side scrubbers are settled and then used to replace dilution water at the biological treatment system. For PSES and PSNS, the biological treatment step is not included since biological treatment is provided at POTWs.

For the BAT model treatment system, a second or extended stage of biological treatment is added. For costing purposes separate aeration, sludge recycle components and clarfiers were considered. The vacuum filter originally installed to treat clarifier underflows at the BPT level of treatment is modified to handle the additional sludge from the BAT system. While not included in the model treatment system, a final polishing from the second clarifier overflow can be provided by filtration to control carryover of suspended matter and any toxic organic pollutants entrained in the suspended solids. This combination of treatment components can provide more complete removal of toxic organic pollutants while also minimizing the discharge of particulates and toxic metal pollutants. One alternative to achieve further reduction of toxic organic pollutants involves the addition of powdered activated carbon to the activated sludge, thereby further enhancing organic and color removal. Using the biologically treated wastewater for coke quenching may achieve a "no discharge of process wastewater" condition, but is not universally applicable because of adverse impacts on air quality.

The NSPS model treatment system includes most of the BAT, BCT and PSES model treatment system components, although in somewhat different order. Flow minimization occurs earlier, since it can be included in initial plant designs without regard for existing treatment components in place. Also, an advanced ammonia and cyanide stripping system is available which can provide somewhat lower levels in the wastewater sent to the biological systems. The addition of powdered activated carbon is a possible alternative for NSPS. The disposal of treated wastewater by quenching is not considered to be appropriate for new sources for the reasons cited above.

Beehive cokemaking operators can achieve zero discharge as set out in the BPT limitations by recycling all of the settling basin overflows back to quenching operations. This control and treatment technology is the basis for BAT, BCT, or NSPS limitations and standards for the beehive segment of the cokemaking subcategory. Since beehive cokemaking operations are located in areas remote from POTWs, and it is highly unlikely that new beehive operations will be built, the Agency has not promulgated pretreatment standards for beehive cokemaking.

Plant Visits

Nine by-product coke plants and three beehive coke plants were visited during this study; four by-product and all beehive plants during the spring of 1973, and the remaining five by-product plants during 1977 and 1978. Table VII-1 provides a key to the symbols used in Tables VII-2, 3 and 4 and other tables to describe control and treatment technology. Tables VII-2 through VII-4 present raw wastewater and effluent concentrations and discharge loadings for each plant studied during the two surveys. A brief description of each wastewater treatment system follows. More details are available on the wastewater flow diagrams as indicated by a figure for each plant visited.

Plant A (0432B) - Figure VII-1

Excess ammonia liquor, final cooler blowdown, and benzol plant wastewaters are subjected to free ammonia stripping, then to dephenolization by the solvent extraction technique. Dephenolized liquors are conveyed to a settling sump, then to the receiving stream. Barometric condenser water discharges direct to the receiving stream without treatment. Quench runoffs are recycled to extinction. Only fresh water is used for quench makeup.

Plant B (0112) - Figure VII-2

Excess ammonia liquor is collected and equalized (five day retention); diluted 3:1 with noncontact cooling water from light oil coolers; blended with phosphoric acid, antifoam and steam; treated in a single-stage aerated activated sludge lagoon (8 hour retention); clarified; and discharged to the receiving stream. The bulk of the sludge is recirculated, with minor blowdown of sludge to a sewage treatment plant. Final cooler blowdown and benzol plant wastewaters are diluted 1:2 and are disposed of by coke quenching. Quench waters are recycled to extinction. Coke wharf drainage is collected and impounded in a lagoon with no outlet.

Plant C (0384A) - Figure VII-3

Excess ammonia liquor is dephenolized by light oil extraction; stripped of free and fixed ammonia; settled (two to three hour retention); and discharged to a POTW for further treatment. Final cooler blowdown and benzol plant wastewaters are used as makeup for coke quenching. Quench runoff and coke wharf drainage are recycled to extinction at quench stations. At least one quench station uses fresh water makeup only.

Plant D (0272) - Figure VII-4

Excess ammonia liquor is conveyed to a desulfurizer tower; filtered (ceramic media); dephenolized by solvent extraction; stripped of free and fixed ammonia; diluted (88:1) by a cooling water stream; and, discharged to the receiving stream. Quench stations use fresh water makeup only, with no discharge.

Plant 001 (0732A) - Figure VII-5

Excess ammonia liquor is equalized; stripped of free ammonia; dephenolized by vapor recirculation; diluted (85:1) with cooling water and other wastewater flows; and discharged to a receiving stream.

Final cooler blowdown is diluted at 2:1 and disposed of by coke quenching. Quench runoff recycles to extinction. The installation of an advanced physical-chemical treatment system combining adsorption by activated carbon and chlorination was under construction at the time of the survey.

Plant 002 (0464C) - Figure VII-6

Excess ammonia liquor and final cooler blowdown is dephenolized by extraction with light oils; chlorinated on a batch basis under alkaline conditions; settled; and, discharged to a POTW. Blowdowns from a quenching car scrubber system and fresh water are used as makeup for coke quenching, which is recycled to extinction.

Plant 003 (0868A) - Figure VII-7

Excess ammonia liquor and miscellaneous wastewaters are equalized; diluted; stripped of ammonia and cyanides by an advanced free and fixed still system; treated in two step (or extended) bio-oxidation lagoons with aeration, clarification, secondary settling, oil skimming; and, discharged to terminal treatment lagoon with other steel plant wastewaters. The final effluent is discharged to a receiving stream. Final cooler wastewaters are recirculated with no blowdown; noncontact cooling water is recycled over cooling towers and used as the sole makeup to all quenching operations. Excess quench water is recycled to extinction.

Plant 008 (0920F) - Figure VII-8

Excess ammonia liquor is routed through free and fixed ammonia stills; blended with benzol plant wastewaters; equalized; cooled; treated in parallel (only one stage operating during survey) bio-oxidation reactors; flocculated with alum and polymer; settled; and, discharged to a receiving stream. Quenching stations use only fresh water for makeup and have no discharge.

Plant 009 (0684F) - Figure VII-9 (Physical/chemical system)

Excess ammonia liquor from three coke plants (one off-site) is mixed; passed through a gas flotation unit (with a side stream through dephenolization); mixed media filtration; adsorption on activated carbon; and, free and fixed ammonia stripping. Benzol plant wastewaters from two plants are mixed; passed through gas flotation; mixed media filtration; and, adsorption by activated carbon prior to disposal in coke quenching.

Plant E (0428A) - Figure VII-10

Coke quench runoffs are treated "once-through" in simple settling ponds, with no provision for recycle.

Plant F (0428A) - Figure VII-11

Coke quench runoffs are collected in a settling basin. The overflows are recirculated to quench stations with no aqueous discharge from the plant.

Plant G (0724G) - Figure VII-12

Coke quench runoffs are collected in primary settling ponds, further clarfied in secondary settling ponds, and are recycled to quench stations. There is no wastewater discharge from this plant.

Summary of Monitoring Data

A review of data presented in Tables VII-2 through VII-4 shows that certain bio-oxidation and carbon adsorption systems are effective in reducing toxic organic pollutants to low levels from by-product cokemaking operations, and that the total recycle of wastewater in beehive cokemaking operations effectively controls discharges from these plants.

Biological systems have been used for treating cokemaking wastewaters for a number of years, with the removal of phenolic compounds as a primary goal. Although a great deal of information is available on the performance of activated sludge units in controlling phenolic compounds, the development of data regarding toxic pollutants other than phenolic compounds and cyanides has only recently been undertaken. Less operating data for toxic organic pollutants are available from full scale activated carbon adsorption treatment plants since, thus far, only two companies have installed and operated such technology. EPA sampling survey data demonstrate that either technique can eliminate more than 90% of all toxic organic pollutants present in coke plant wastewaters, although the biological systems have certain operating cost advantages.

Originally, advanced levels of treatment using biological systems were expected to involve multiple stages for accomplishing selective degradation of pollutants in series, e.g., ammonia and cyanide removal, nitrification and denitrification. The two bio-plants surveyed for toxic pollutant removals (Plants 003 and 008) control toxic pollutants using a single stage (008) or two identical stages in series (003). The second stage at Plant 008 has been put into operation since it was originally surveyed. Overall removal of toxic organic pollutants averaged better than 90% with phenolic compounds, naphthalene, benzo(a)pyrene, acenaphthylene and xylene reduced at rates greater than 99%. Chloroform appeared to be the major toxic organic pollutant which persists in the final effluents, at concentrations of 0.2 mg/l. Measurable amounts of benzene and toluene also remain, even though the systems have removal efficiencies of 96.7% or better. High concentrations of these two pollutants were originally present in raw wastewater, thus even very effective removal efficiencies still leave behind measurable residues. Despite the continued presence of fractions of a milligram per liter for a limited number of organic pollutants, activated sludge systems proved to be very effective in controlling toxic organic effluents from coke plants. The model BAT biological treatment system has been shown to remove virtually all toxic organic pollutants to near detectable levels.

Data for one of the full-scale carbon adsorption systems is presented wherever Plant 009 is discussed. These data demonstrate uniformly good removal efficiencies for most of the toxic organic pollutants. Exceptions include chloroform and acrylonitrile, which was reduced by 74.3% but still appeared at a concentration of 0.19 mg/l in the effluent. Poor removal efficiencies for ethylbenzene and parachlorometacresol are primarily due to their extremely low concentrations in untreated wastewater, <0.002 and 0.007 mg/l respectively. In general, field sampling at Plant 009 demonstrates the effectiveness of activated carbon adsorption for treating toxic organic pollutants.

Comparison of Data

As mentioned above, the availability of long-term data for many of the toxic pollutants is limited. However, considerable data are available for pollutants such as phenols (4-AAP), cyanides, ammonia-N, oil and grease, and suspended solids. Table VII-5 compares the long-term data for those pollutants reported for two plants, with short-term results observed during EPA sampling surveys at the same sampling point. With few exceptions, these data are in good agreement.

Effect of Make-up Water Quality

Where the mass loading of a limited pollutant in the make-up water to a process is small in relation to the raw waste loading of that pollutant, the impact of make-up water quality on wastewater treatment system performance is not significant, and, in many cases, not measurable. In these instances, the Agency has determined that the respective effluent limitations and standards should be applied on a gross basis.

Table VII-6 presents an analysis of the effect of make-up water quality on the raw waste loading of each of the pollutants limited in the regulation for the cokemaking subcategory. The make-up water quality data and raw waste load data were obtained from coke plant sampling surveys completed for this study. The analysis demonstrates that make-up water quality for all limited pollutants except suspended solids is insignificant compared to the raw waste loading. Note that for suspended solids in the make-up water, the next highest concentration to the maximum concentration of 287 mg/l is 11 mg/l. Notwithstanding the potential for high levels of suspended solids in make-up waters, the model biological treatment systems contain bio-oxidation units that operate with mixed-liquor suspended solids levels of up to 5000 to 10,000 mg/l. These solids are removed prior to discharge. Thus, the impact of high make-up water suspended solids concentrations is not significant for cokemaking operations. The Agency has determined that the limitations and standards should be applied on a gross basis, except to the extent provided by 40 CFR 122.63(h).

TABLE VII-1

OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS

Symbols

A. Operating Modes

1. OT — Once-Through

2. Rt,s,n — Recycle, where t = type waste
s = stream recycled
n = % recycled

t: U = Untreated
T = Treated

	s	n
P	Process Wastewater	% of raw waste flow
F	Flume Only	% of raw waste flow
S	Flume and Sprays	% of raw waste flow
FC	Final Cooler	% of FC flow
BC	Barometric Cond.	% of BC flow
VS	Abs. Vent Scrub.	% of VS flow
FH	Fume Hood Scrub.	% of FH flow

3. REt,n — Reuse, where t = type
n = % of raw waste flow

t: U = before treatment
T = after treatment

4. BDn — Blowdown, where n = discharge as % of raw waste flow

B. Control Technology

10. DI — Deionization

11. SR — Spray/Fog Rinse

12. CC — Countercurrent Rinse

13. DR — Drag-out Recovery

C. Disposal Methods

20. H — Haul Off-Site

21. DW — Deep Well Injection

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS
PAGE 2

C. Disposal Methods (cont.)

22.	Qt,d	Coke Quenching, where t = type d = discharge as % of makeup t: DW = Dirty Water CW = Clean Water
23.	EME	Evaporation, Multiple Effect
24.	ES	Evaporation on Slag
25.	EVC	Evaporation, Vapor Compression Distillation

D. Treatment Technology

30.	SC	Segregated Collection
31.	E	Equalization/Blending
32.	Scr	Screening
33.	OB	Oil Collecting Baffle
34.	SS	Surface Skimming (oil, etc.)
35.	PSP	Primary Scale Pit
36.	SSP	Secondary Scale Pit
37.	EB	Emulsion Breaking
38.	A	Acidification
39.	AO	Air Oxidation
40.	GF	Gas Flotation
41.	M	Mixing
42.	Nt	Neutralization, where t = type t: L = Lime C = Caustic A = Acid W = Wastes O = Other, footnote

D. Treatment Technology (cont.)

43.	FLt	Flocculation, where t = type t: L = Lime A = Alum P = Polymer M = Magnetic O = Other, footnote
44.	CY	Cyclone/Centrifuge/Classifier
44a.	DT	Drag Tank
45.	CL	Clarifier
46.	T	Thickener
47.	TP	Tube/Plate Settler
48.	SLn	Settling Lagoon, where n = days of retention time
49.	BL	Bottom Liner
50.	VF	Vacuum Filtration (of e.g., CL, T, or TP underflows)
51.	Ft,m,h	Filtration, where t = type m = media h = head

t	m	h
D = Deep Bed	S = Sand	G = Gravity
F = Flat Bed	O = Other, footnote	P = Pressure

52.	CLt	Chlorination, where t = type t: A = Alkaline B = Breakpoint
53.	CO	Chemical Oxidation (other than CLA or CLB)

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT
TECHNOLOGIES AND DISPOSAL METHODS
PAGE 4

D. Treatment Technology (cont.)

54.	BOt	Biological Oxidation, where t = type t: An = Activated Sludge n = No. of Stages T = Trickling Filter B = Biodisc O = Other, footnote
55.	CR	Chemical Reduction (e.g., chromium)
56.	DP	Dephenolizer
57.	ASt	Ammonia Stripping, where t = type t: F = Free L = Lime C = Caustic
58.	APt	Ammonia Product, where t = type t: S = Sulfate N = Nitric Acid A = Anhydrous P = Phosphate H = Hydroxide O = Other, footnote
59.	DSt	Desulfurization, where t = type t: Q = Qualifying N = Nonqualifying
60.	CT	Cooling Tower
61.	AR	Acid Regeneration
62.	AU	Acid Recovery and Reuse
63.	ACt	Activated Carbon, where t = type t: P = Powdered G = Granular
64.	IX	Ion Exchange
65.	RO	Reverse Osmosis
66.	D	Distillation

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT
TECHNOLOGIES AND DISPOSAL METHODS
PAGE 5

D. Treatment Technology (cont.)

67.	AA1	Activated Alumina
68.	OZ	Ozonation
69.	UV	Ultraviolet Radiation
70.	CNTt,n	Central Treatment, where t = type n = process flow as % of total flow t: 1 = Same Subcats. 2 = Similar Subcats. 3 = Synergistic Subcats. 4 = Cooling Water 5 = Incompatible Subcats.
71.	On	Other, where n = Footnote number
72.	SB	Settling Basin
73.	AE	Aeration
74.	PS	Precipitation with Sulfide

TABLE VII-2

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES STUDY
BY-PRODUCT COKEMAKING OPERATIONS

Raw Wastewaters										
Reference Code	0432B		0112		0384A		0272		Average of 4	
Plant Code	A		B		C		D		-	
Sample Point(s)	4+5[(1)]		1+4[(1)]		1+3[(1)]		1			
Flow (Gal/Ton)	139		127		134		21.6		105	
	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb
Suspended Solids	24	0.0139	36	0.0191	129	0.0721	30	0.00270	55	0.0270
Oil & Grease	21	0.0122	240	0.127	93	0.0520	147	0.0132	125	0.0511
Ammonia-N	1564	0.907	1137	0.602	1729	0.966	3715	0.335	2036	0.703
Sulfides	8.9	0.00516	629	0.333	152	0.0849	183	0.0165	243	0.110
Thiocyanates	112	0.0649	233	0.123	28.4	0.0159	128	0.0115	125	0.0538
pH (Units)	9.4	-	8.3	-	8.1	-	8.7	-	8.1-9.4	
121 Cyanides	101	0.0585	114	0.0604	61.8	0.0345	145	0.0131	105	0.0416
191 Phenolic Cpds.	448	0.260	354	0.187	358	0.200	708	0.0638	467	0.178

Treated Effluents								
Sample Point(s)	2+4[(1)]		2		2[(2)]		2	
Flow (Gal/Ton)	156		108		40.6		28.8	
C&TT	ASF,DP,SB		E,BOA-1,QDW		DP,ASL,QDW		DSN,DP,ASL	
	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb
Suspended Solids	5	0.00325	163[(3)]	0.0734	102	0.0173	537[(3)]	0.0645
Oil & Grease	3.4	0.00221	2.5	0.00113	19	0.00322	12.4	0.00149
Ammonia-N	797	0.518	957	0.431	388	0.0657	114	0.0137
Sulfides	0.71	0.000462	0.26	0.000117	113	0.0191	91	0.0109
Thiocyanates	29	0.0189	12.5	0.00563	64	0.0108	88	0.0106
pH (Units)	8.6	-	7.5	-	9.5-11.8		11.7	-
121 Cyanides	95	0.0618	3.77	0.00170	68	0.0115	124	0.0149
191 Phenolic Cpds.	1.32	0.000859	0.064	0.000029	219	0.0371	5.13	0.000616

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(1) The mg/l values represent concentrations which would be present in the combined wastewaters.
(2) Plant discharges to a POTW.
(3) No sedimentation provided.

NOTE: For definition of C&TT Codes see Table VII-1

TABLE VII-3

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS

Raw Wastewaters:

	Reference Code	0732A		0464C		0868A		0920F		0684F			
	Plant Code	001		002		003		008		009		Average of 4$^{(2)}$	
	Sample Point(s)	C+D$^{(1)}$		B		C		B+(D-C)$^{(1)}$		B+G$^{(1)}$		-	
	Flow (Gal/Ton)	5142$^{(2)}$		35.9		27.8		55.8		96.7		54.1	
		mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb
	Suspended Solids	177	3.80	14	0.00210	80	0.00927	61	0.0142	86	0.0347	60	0.0151
	Oil & Grease	27	0.579	82	0.0123	184	0.0213	113	0.0263	126	0.0508	126	0.0277
	Ammonia-N	111	2.38	5067	0.759	2387	0.277	2696	0.627	4109	1.66	3565	0.831
	Phenolic Cpds.	9.08	0.195	702	0.105	626	0.0726	734	0.171	1067	0.430	782	0.195
	Sulfides	2.8	0.0600	1833	0.274	439	0.0509	528	0.123	515	0.208	829	0.164
	Thiocyanates	26	0.557	1245	0.186	592	0.0686	383	0.0891	453	0.183	668	0.132
	pH (Units)	6.9-7.9		9.0-9.1		9.6-9.8		8.8-11.7		8.4-8.6		6.9-11.7	
3	Acrylonitrile	0.021	0.000450	4.67	0.000700	ND	ND	2.81	0.000654	.745	0.000300	2.06	0.000414
4	Benzene	13.2	0.283	2.83	0.000424	27.2	0.00315	34.2	0.00796	45.6	0.0184	27.5	0.00748
21	2,4,6-Trichlorophenol	ND	ND	0.400	0.000060	ND	ND	ND	ND	ND	ND	0.100	0.000015
22	Parachloronitrolcresol	ND	ND	4.33	0.000648	ND	ND	ND	ND	0.007	0.000003	1.08	0.000163
23	Chloroform	ND	ND	<0.003	*	1.37	0.000159	0.275	0.000064	0.0321	0.000013	0.419	0.000059
34	2,4-Dimethylphenol	ND	ND	83.7	0.0125	5.33	0.000618	2.34	0.000544	ND	ND	22.8	0.00342
35	2,4-Dinitrotoluene	0.529	0.0113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
36	2,6-Dinitrotoluene	0.138	0.00296	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
38	Ethylbenzene	ND	ND	0.297	0.000044	0.640	0.000074	0.336	0.000078	<0.003	*	0.318	0.000049
39	Fluoranthene	0.018	0.000386	0.977	0.000146	3.13	0.000363	0.975	0.000227	0.588	0.000237	1.42	0.000243
54	Isophorone	0.055	0.00118	ND	ND	ND	ND	<0.002	*	ND	ND	0	0
55	Naphthalene	1.92	0.0412	10.6	0.00159	28.9	0.00335	22.7	0.00528	27.5	0.0111	22.4	0.00533
60	4,6-Dinitro-o-cresol	ND	ND	0.967	0.000145	ND	ND	ND	ND	0.0440	0.000018	0.253	0.000041
64	Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	0.788	0.000318	0.197	0.000080
65	Phenol	3.09	0.0663	666	0.0997	327	0.0379	240	0.0558	78.9	0.0318	328	0.0563
(3)	Phthalates, Total	1.06	0.0227	1.98	0.000296	2.30	0.000267	1.05	0.000244	6.80	0.00274	3.03	0.000887
72	Benzo(a)anthracene	0.002	0.000043	<0.007	*	ND	ND	0.008	0.000002	0.617	0.000249	0.156	0.000063
73	Benzo(a)pyrene	0.001	0.000021	0.513	0.000077	ND	ND	0.115	0.000027	0.109	0.000044	0.184	0.000037
76	Chrysene	0.001	0.000021	0.287	0.000043	ND	ND	0.124	0.000029	0.805	0.000325	0.304	0.000099
77	Acenaphthylene	0.017	0.000365	3.20	0.000479	6.37	0.000738	2.78	0.000647	2.66	0.00107	3.75	0.000734
80	Fluorene	0.029	0.000622	0.770	0.000115	2.47	0.000286	0.488	0.000114	0.267	0.000108	1.00	0.000156
84	Pyrene	0.004	0.000086	0.817	0.000122	2.63	0.000305	0.414	0.000096	0.617	0.000249	1.12	0.000193
86	Toluene	1.88	0.0403	0.910	0.000136	8.92	0.00103	5.45	0.00127	6.13	0.00247	5.35	0.00123
130	Xylene	ND	ND	<0.010	<0.000002	<0.01	*	ND	ND	101	0.0407	25.3	0.0102
114	Antimony	<0.004	<0.00009	0.033	0.000005	NA	NA	0.138	0.000032	0.246	0.000099	0.139	0.000045
115	Arsenic	0.005	0.000107	0.267	0.000040	NA	NA	0.382	0.000089	0.133	0.000054	0.261	0.000061
121	Cyanides	3.29	0.0705	21.5	0.00322	22.3	0.00259	16.6	0.00386	28.5	0.0115	22.2	0.00529
125	Selenium	<0.003	<0.00006	0.457	0.000068	NA	NA	1.03	0.000240	0.066	0.000027	0.518	0.000112
126	Silver	<0.025	<0.00054	<0.025	<0.000004	<0.001	*	0.074	0.000017	<0.020	<0.000008	0.018	0.000004
128	Zinc	0.218	0.00467	0.241	0.000036	0.130	0.000015	0.271	0.000063	<0.100	<0.00004	0.160	0.000028

TABLE VII-3
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS
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Treated Effluents

	Reference Code	0732A		0464C		0868A		0920F		0684F	
	Plant Code	001		002		003		008		009	
	Sample Point(s)	D		D		E		E		F+J$^{(1)(4)}$	
	Flow (Gal/Ton)	5072		35.9$^{(5)}$		201		139		96.7	
	C&TT	ASF,DP		DP,CLA		ASC,BOA2,CL,SB,SS		ASL,E,CT,BOA1,CL		DP,GF,FDSP,ACG,ASF	
		mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb
	Suspended Solids	179	3.79	6	0.000898	39	0.0327	43	0.0249	30	0.0121
	Oil & Grease	27	0.571	40	0.00599	4	0.00335	8	0.00464	9	0.00363
	Ammonia-N	112	2.37	4875	0.730	0.77	0.000645	127	0.0736	213	0.0859
	Phenolic Cpds.	7.8	0.165	84.1	0.0126	0.028	0.000023	0.056	0.000033	0.755	0.000304
	Sulfides	3	0.0634	1730	0.259	<0.3	<0.00025	0.21	0.000122	527	0.213
	Thiocyanates	26	0.550	1048	0.157	<0.9	<0.00075	0.84	0.000487	397	0.160
	pH (Units)	6.9-7.9		8.9-9.0		7.4-7.5		7.5-7.8		8.8-9.9	
3	Acrylonitrile	ND	ND	3.00	0.000449	ND	ND	ND	ND	0.190	0.000077
4	Benzene	12.8	0.271	120	0.0180	<0.060	<0.00005	<0.257	<0.00015	<0.010	<0.000004
21	2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22	Parachlorometacresol	ND	ND	ND	ND	0.064	0.000054	ND	ND	<0.003	*
23	Chloroform	ND	ND	ND	ND	<0.281	<0.00024	0.203	0.000118	0.045	0.000018
34	2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	2,4-Dinitrotoluene	0.510	0.0108	ND	ND	ND	ND	ND	ND	ND	ND
36	2,6-Dinitrotoluene	0.137	0.00290	ND	ND	ND	ND	ND	ND	ND	ND
38	Ethylbenzene	ND	ND	4.40	0.000659	0.039	0.000033	0.014	0.000008	<0.007	<0.000003
39	Fluoranthene	0.003	0.000063	0.503	0.000075	0.008	0.000007	<0.003	<0.000002	<0.007	<0.000003
54	Isophorone	ND	ND	0.167	0.000025	ND	ND	ND	ND	ND	ND
55	Naphthalene	1.40	0.0296	5.87	0.000879	ND	ND	<0.003	<0.000002	<0.005	<0.000002
60	4,6-Dinitro-o-cresol	ND	ND	ND	ND	ND	ND	ND	ND	<0.005	<0.000002
64	Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	0.025	0.000010
65	Phenol	2.30	0.0486	52.8	0.00790	<0.015	<0.000012	0.040	0.000023	0.048	0.000019
(3)	Phthalates, Total	0.689	0.0146	1.87	0.000280	0.192	0.000161	3.54	0.00205	0.188	0.000076
72	Benzo(a)anthracene	ND	ND	ND	ND	<0.002	<0.000002	0.027	0.000016	<0.005	<0.000002
73	Benzo(a)pyrene	ND	ND	0.013	0.000002	0.013	0.000011	ND	ND	<0.002	*
76	Chrysene	ND	ND	0.095	0.000014	<0.006	<0.000005	0.010	0.000006	<0.005	<0.000002
77	Acenaphthylene	0.013	0.000275	1.60	0.000240	<0.007	<0.000006	<0.003	<0.000002	<0.005	<0.000002
80	Fluorene	0.027	0.000571	0.190	0.000028	<0.010	<0.000008	<0.003	<0.000002	<0.005	<0.000002
84	Pyrene	0.003	0.000063	0.277	0.000042	0.026	0.000022	0.007	0.000004	<0.007	<0.000003
86	Toluene	1.67	0.0353	10.5	0.00157	0.040	0.000034	0.073	0.000042	<0.007	<0.000003
130	Xylene	ND	ND	25.4	0.00380	ND	ND	ND	ND	<0.005	<0.000002
114	Antimony	<0.004	<0.00008	0.041	0.000006	NA	NA	0.133	0.000077	<0.22	<0.00009
115	Arsenic	0.005	0.000106	0.140	0.000021	NA	NA	0.403	0.000234	0.149	<0.00006
121	Cyanides	0.72	0.0152	16.2	0.00243	2.34	0.00196	2.45	0.00142	22.5	0.00907
125	Selenium	<0.003	<0.00006	0.633	0.000095	NA	NA	0.650	0.000377	0.034	0.000014
126	Silver	<0.025	<0.0005	<0.025	<0.000004	<0.002	<0.000002	<0.010	<0.000006	<0.020	<0.000008
128	Zinc	0.220	0.00465	0.126	0.000019	<0.060	<0.00005	0.087	0.000050	<0.005	<0.000002

TABLE VII-3
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
BY-PRODUCT COKEMAKING OPERATIONS
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FOOTNOTES:

ND: None detected.
NA: Not analyzed.
* : <0.000001 lb/1000 lb.

(1) The mg/l values represent concentrations which would be present in the combined wastewaters.
(2) Average does not include samples from plant 001 because of the presence of over 5000 GPT non-contact cooling water in mixed samples.
(3) Values shown are the sum of all mg/l in lb/1000 lb for the following phthalates: 66 Bis-(2-ethylhexyl); 67 Butylbenzyl; 68 Di-n-butyl; 69 Di-n-octyl; 70 Diethyl and 71 Dimethyl phthalate.
(4) Effluent is the sum of direct discharge F and treated wastewater J which is disposed of by quenching.
(5) Plant discharges to POTW for further treatment.

NOTE: For definition of C&TT Codes, see Table VII-1.

TABLE VII-4

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES STUDY
BEEHIVE COKEMAKING OPERATIONS

Raw Wastewaters

	0428A		0428A		0724G			
Refence Code	0428A		0428A		0724G			
Plant Code	E		F		G		Average of 3	
Sample Point(s)	3		1		1		-	
Flow (Gal/Ton)	490		490		123		368	
	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb	mg/l	lb/1000 lb
Suspended Solids	165	0.337	65	0.133	937	0.481	389	0.317
Oils and Greases	0.8	0.00163	0.9	0.00184	8.2	0.00421	3.3	0.00256
Ammonia-N	0.33	0.000674	0.37	0.000756	0.43	0.000221	0.38	0.000550
Sulfide	<0.02	<0.00004	<0.02	<0.00004	0.18	0.000092	0.07	0.000057
Thiocyanate	<3	<0.006	<3	<0.006	7	0.00359	4	0.00520
pH (Units)	7.3		7.3		7.0-7.3		7.0-7.3	
121 Cyanides	0.005	0.000010	0.035	0.000072	2.27	0.00116	0.77	0.000414
191 Phenolic Cpds.	0.016	0.000033	0.073	0.000149	22.6	0.0116	7.56	0.00393

Treated Effluents

Sample Point(s)	4		2		2	
Flow (Gal/Ton)	490		0		0	
C&TT	SB		SB,RTP100		PSP,SB,RTP100	
	mg/l	lb/1000 lb	mg/l(1)	lb/1000 lb	mg/l(1)	lb/1000 lb
Suspended Solids	36	0.0736	36	0	210	0
Oils & Greases	0.2	0.000410	0.8	0	3.9	0
Ammonia-N	0.20	0.000410	0.67	0	0.44	0
Sulfide	<0.02	<0.00004	<0.02	0	0.14	0
Thiocyanate	<3	<0.006	<3	0	12	0
pH (Units)	7.1		7.3		6.8-7.1	
121 Cyanides	0.004	0.000008	0.049	0	2.62	0
191 Phenolic Cpds.	0.014	0.000029	0.132	0	24.2	0

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(1) : Concentrations shown refer to the recycled water quality. Plant achieves zero discharge.

NOTE: For definition of C&TT Codes, see Table VII-1.

TABLE VII-5

DATA COMPARISON - PLANT LONG-TERM VS. SAMPLING VISIT
BY-PRODUCT COKEMAKING

Plant, Location & Parameter	Sample Data Base		Concentrations(1)				EPA Samples(1)		Within(3) 1 Std. Dev.	Within(4) Range
	Frequency	Number	Max.	Min.	Mean	Standard Deviation	Number	Mean		
003: (0868A) 21 to 43 Months of Data										
Biotreatment Plant Clarifier Overflow(5):										
Phenols (4AAP), mg/l	Daily	1303	0.246	0.005	0.021	0.017	3	0.028	X	X
Ammonia-N, mg/l	Daily	1303	124	0.07	7.0	16.8	3	0.77	X	X
Cyanides, mg/l	Daily	1302	17.1	0.25	2.75	1.97	3	2.34	X	X
Settling Basin Effluent (including untreated side steams):										
Phenols (4AAP), mg/l	Weekly	90	5.46	0.015	0.246	0.689	3	0.058	X	X
Ammonia-N, mg/l	Weekly	90	71.4	4.10	17.0	12.6	3	3.33	-1.08	Below
Cyanides, mg/l	Weekly	90	5.03	0.036	0.664	0.573	3	0.511	X	X
pH (Units)	Weekly	90	10.7	6.6	7.8	0.6	3	7.2-7.4	X	X
Oils & Greases, mg/l	Weekly	90	17.7	1.0	4.9	3.8	2	4	X	X
009: (0684F) 5 to 12 Months of Data										
Treated Effluent to River:										
Phenols (4AAP), mg/l	Weekly	50	2.88	<0.01	0.185	0.505	1	0.217	X	X
Ammonia-N, mg/l	Weekly	51	8450	9.9	544	1270	2	290	X	X
Cyanides, mg/l	Weekly	51	250	0.28	23.8	36.2	2	12.8	X	X
pH, (Units)	Weekly	43	13.6	7.6	10.7	1.7	2	8.8-9.0	X	X
Oils & Greases, mg/l	Weekly	50	23	2	5.6	3.7	2	10	+1.19	X
Suspended Solids, mg/l	Weekly	50	224	6	41.8	39.9	2	59	X	X
Dissolved Solids, mg/l	Weekly	50	30,124	1,406	14,677	5,996	2	15,875	X	X
Temperature, °F	Weekly	21	198	164	185	8.4	2	198	+1.55	X
Cadmium, mg/l	Monthly	5	0.059	0.004	0.031	0.020	2	0.04	X	X
Copper, mg/l	Monthly	6	0.101	0.056	0.078	0.017	2	0.03	-2.82	Below
Lead, mg/l	Monthly	6	0.134	0.082	0.110	0.020	2	0.19	+4.00	Above

---

(1) Data were reported in plant responses to D-DCP questionnaires or from follow-up data provided by plants.

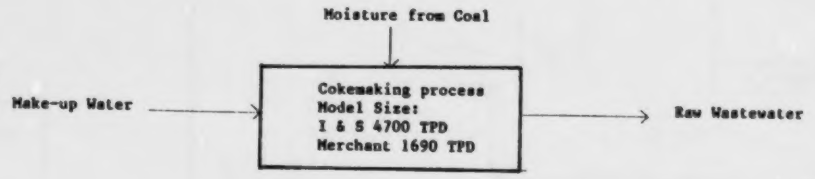
(2) Data were collected during 2 or 3 days of sampling at each plant.

(3) X indicates EPA value is within one standard deviation of plant's long-term mean value. A number in this column indicates that the EPA value is that many standard deviations above or below the plant's long-term value. Plus means above, and minus, below.

(4) X Indicates EPA value is within the long-term maximum and minimum values stated by the plant. If the EPA value is outside that range, the word "above" or "below" indicates direction.

TABLE VII-6

NET CONCENTRATION AND LOAD ANALYSIS
BY-PRODUCT COKEMAKING OPERATIONS



I & S Plants 55* gal/ton x 4700 TPD = 258,500 GPD
Merc. Plants 64* gal/ton x 1690 TPD = 108,160 GPD

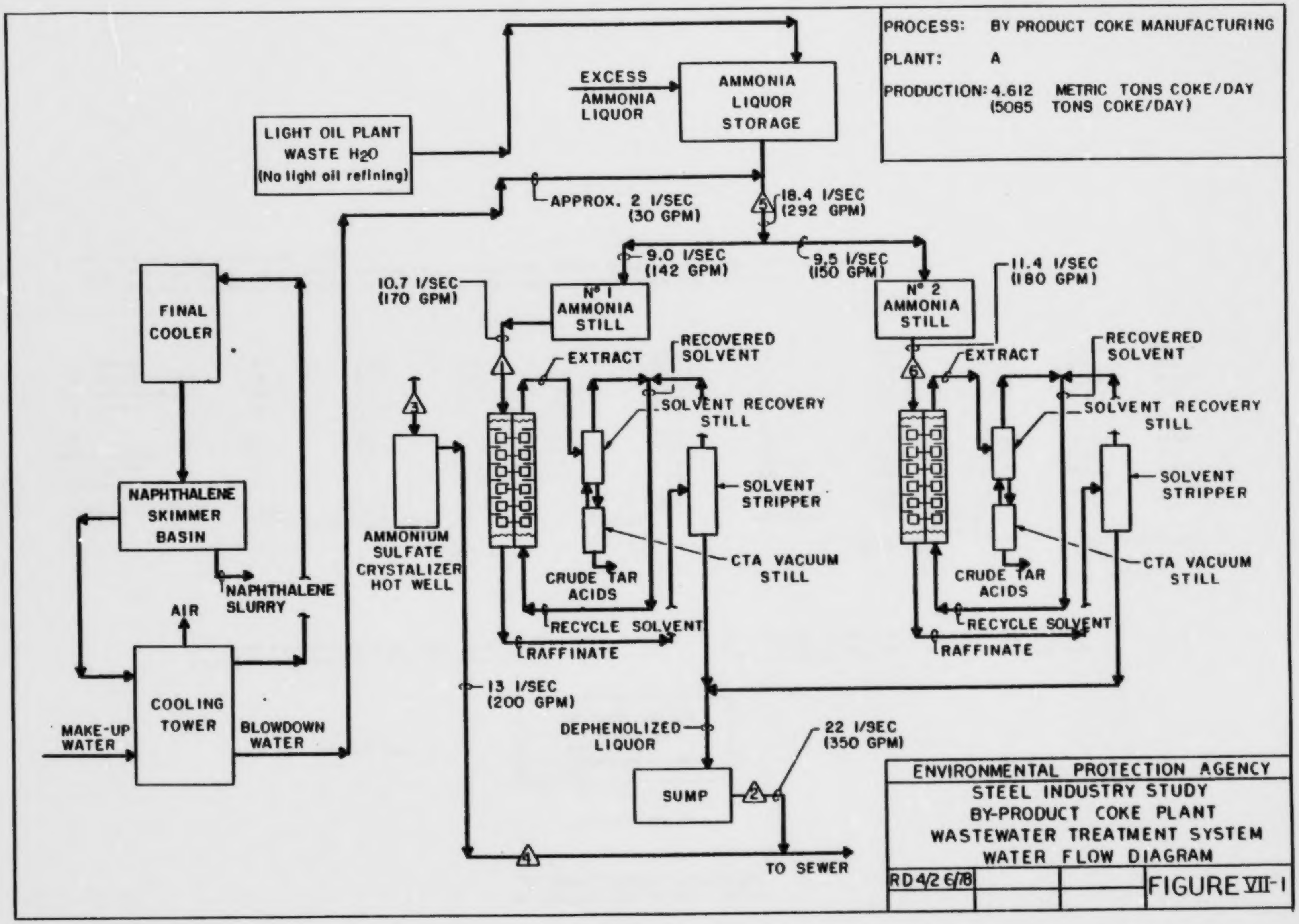
I & S Plants 87 gal/ton x 4700 TPD = 408,900 GPD
Merc. Plants 100 gal/ton x 1690 TPD = 169,000 GPD

	Make-up					Raw Waste			Make-up as a % of Raw Waste Load	
	Concentration (mg/l)			Avg. Load (lbs/day)		Avg. Conc. (mg/l)	Avg. Load (lbs/day)			
Regulated Pollutants	Min	Max	Avg	I&S	Merc.		I&S	Merc.	I&S	Merc.
Ammonia-N	0	1.0	0.29	0.625	0.262	600	2046.1	845.7	0.030	0.031
Oil & Grease	1	18	6.2	13.4	5.59	75	255.8	105.7	5.2	5.3
Phenols (4AAP)	<0.001	0.015	0.005	0.011	0.005	300	1023.1	422.8	0.0011	0.0012
TSS	<1	287**	42	90.5	37.9	50	170.5	70.5	53.1	53.8
4 Benzene	ND	<0.010	0.0	0.0	0.0	35	119.4	49.3	0.0	0.0
55 Naphthalene	ND	0.120	0.017	0.037	0.015	30	102.3	42.3	0.036	0.035
73 Benzo(a)pyrene	ND	<0.010	0.0	0.0	0.0	0.1	0.34	0.14	0.0	0.0
121 Cyanide	0	0.024	0.011	0.024	0.010	50	170.5	70.5	0.014	0.014

---

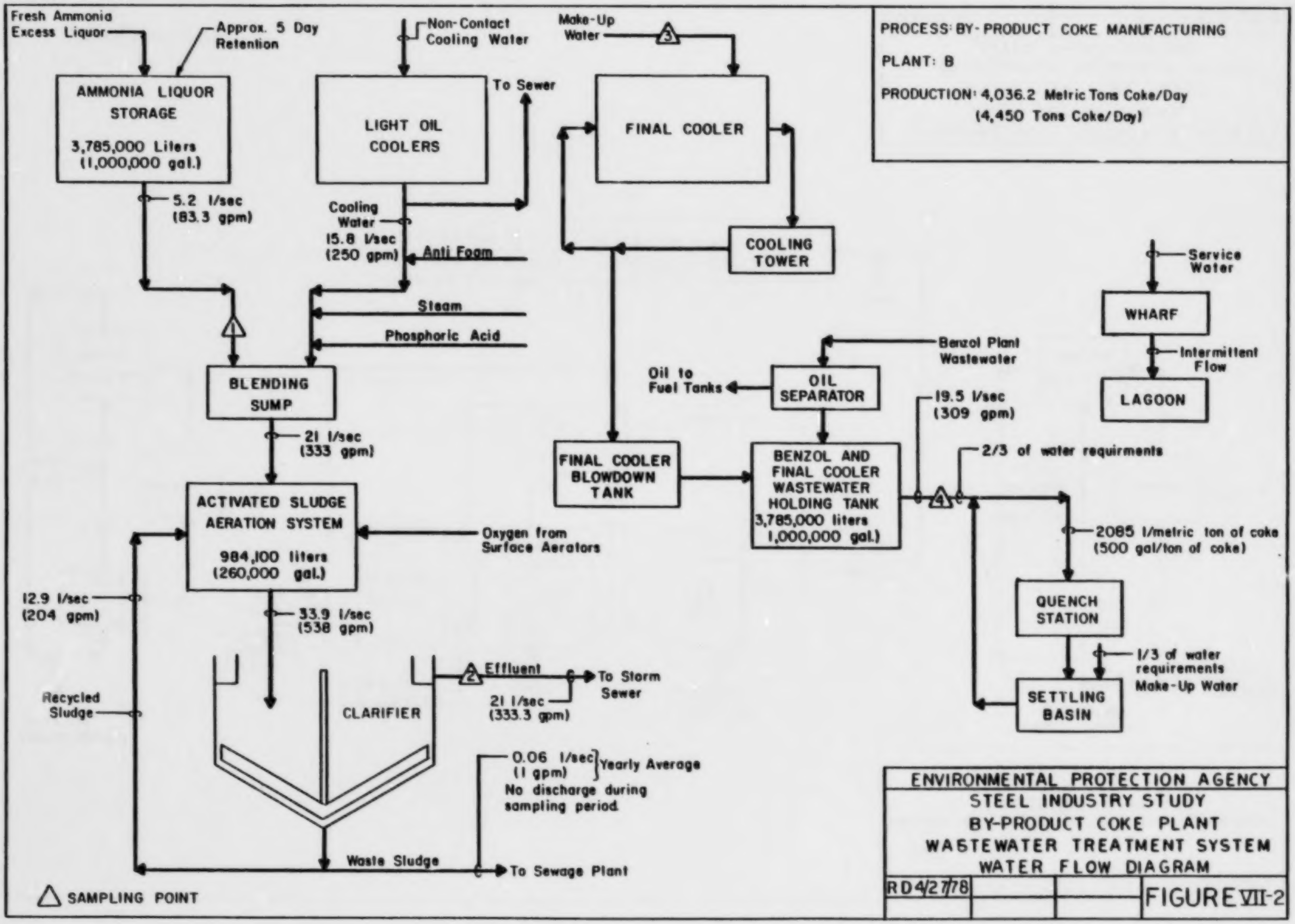
* For plants with barometric condensers on ammonium sulfate crystalizers, an additional make-up flow of 75 GPT would be added. This flow is reduced to 3 - 5 GPT when recycle of these wastewaters is practiced.

** Next highest concentration is 11 mg/l.


LIGHT OIL PLANT WASTE H2O (No light oil refining)
EXCESS AMMONIA LIQUOR
AMMONIA LIQUOR STORAGE
APPROX. 2 l/SEC (30 GPM)
18.4 l/SEC (292 GPM)
5
9.0 l/SEC (142 GPM)
9.5 l/SEC (150 GPM)
10.7 l/SEC (170 GPM)
11.4 l/SEC (180 GPM)
N° 1 AMMONIA STILL
N° 2 AMMONIA STILL
1
6
3
EXTRACT
RECOVERED SOLVENT
SOLVENT RECOVERY STILL
SOLVENT STRIPPER
CTA VACUUM STILL
CRUDE TAR ACIDS
RECYCLE SOLVENT
RAFFINATE
FINAL COOLER
NAPHTHALENE SKIMMER BASIN
NAPHTHALENE SLURRY
AIR
COOLING TOWER
MAKE-UP WATER
BLOWDOWN WATER
AMMONIUM SULFATE CRYSTALIZER HOT WELL
13 l/SEC (200 GPM)
DEPHENOLIZED LIQUOR
22 l/SEC (350 GPM)
SUMP
2
4
TO SEWER

PROCESS: BY PRODUCT COKE MANUFACTURING
PLANT: A
PRODUCTION: 4.612 METRIC TONS COKE/DAY
(5085 TONS COKE/DAY)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCT COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM
RD 4/2 6/78
FIGURE VII-1


Fresh Ammonia Excess Liquor
Approx. 5 Day Retention
AMMONIA LIQUOR STORAGE
3,785,000 Liters (1,000,000 gal.)
5.2 l/sec (83.3 gpm)
Non-Contact Cooling Water
LIGHT OIL COOLERS
To Sewer
Cooling Water
15.8 l/sec (250 gpm)
Anti Foam
Steam
Phosphoric Acid
1
BLENDING SUMP
21 l/sec (333 gpm)
ACTIVATED SLUDGE AERATION SYSTEM
984,100 liters (260,000 gal.)
Oxygen from Surface Aerators
12.9 l/sec (204 gpm)
33.9 l/sec (538 gpm)
Recycled Sludge
CLARIFIER
2
Effluent
To Storm Sewer
21 l/sec (333.3 gpm)
0.06 l/sec (1 gpm) Yearly Average
No discharge during sampling period.
Waste Sludge
To Sewage Plant
SAMPLING POINT
Make-Up Water
3
FINAL COOLER
COOLING TOWER
FINAL COOLER BLOWDOWN TANK
Oil to Fuel Tanks
OIL SEPARATOR
Benzol Plant Wastewater
BENZOL AND FINAL COOLER WASTEWATER HOLDING TANK
3,785,000 liters 1,000,000 gal.)
19.5 l/sec (309 gpm)
4
2/3 of water requirments
2085 l/metric ton of coke (500 gal/ton of coke)
QUENCH STATION
1/3 of water requirements Make-Up Water
SETTLING BASIN
Service Water
WHARF
Intermittent Flow
LAGOON
RD4/27/78

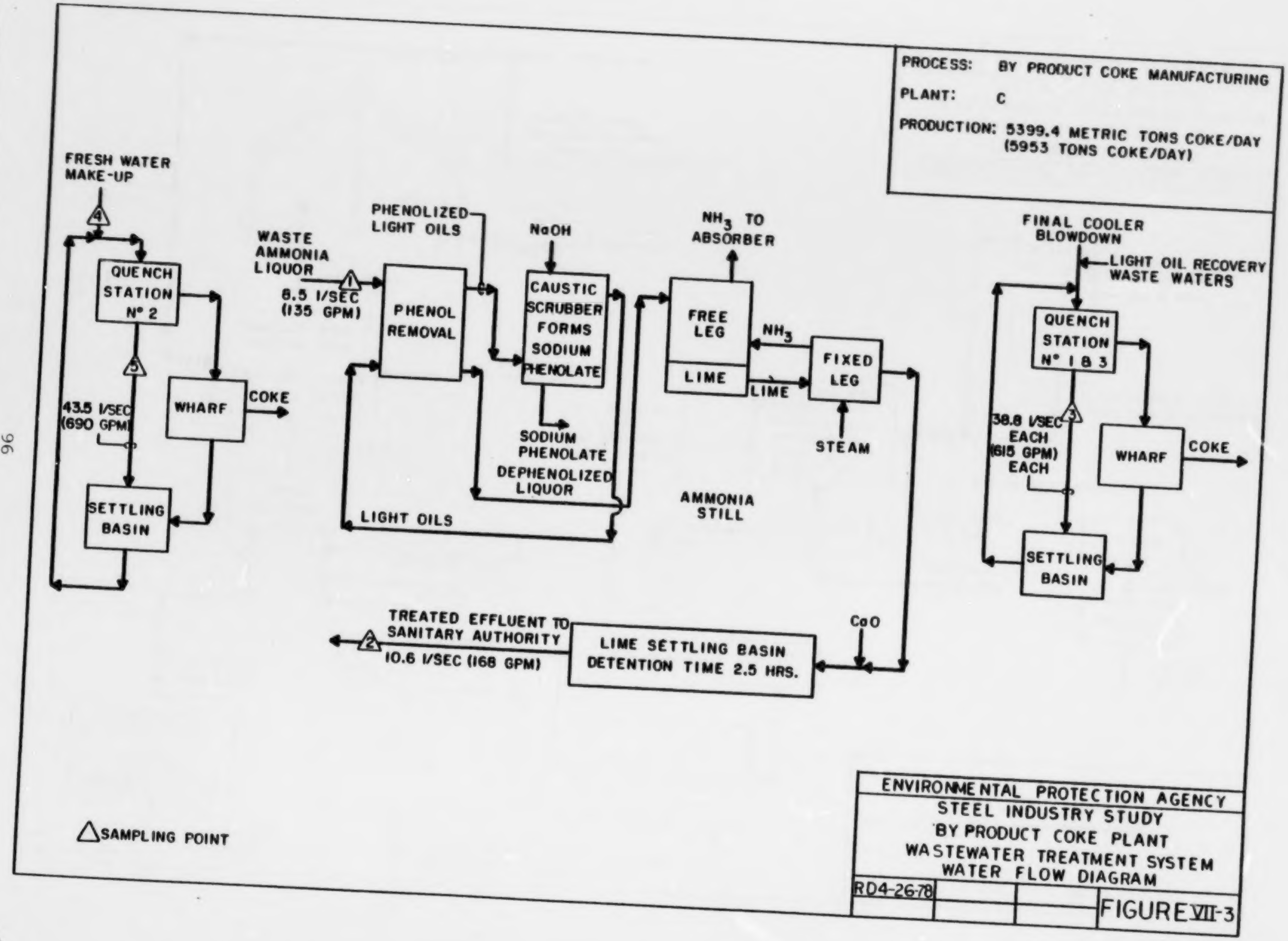
PROCESS: BY-PRODUCT COKE MANUFACTURING

PLANT: B

PRODUCTION: 4,036.2 Metric Tons Coke/Day
(4,450 Tons Coke/Day)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCT COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

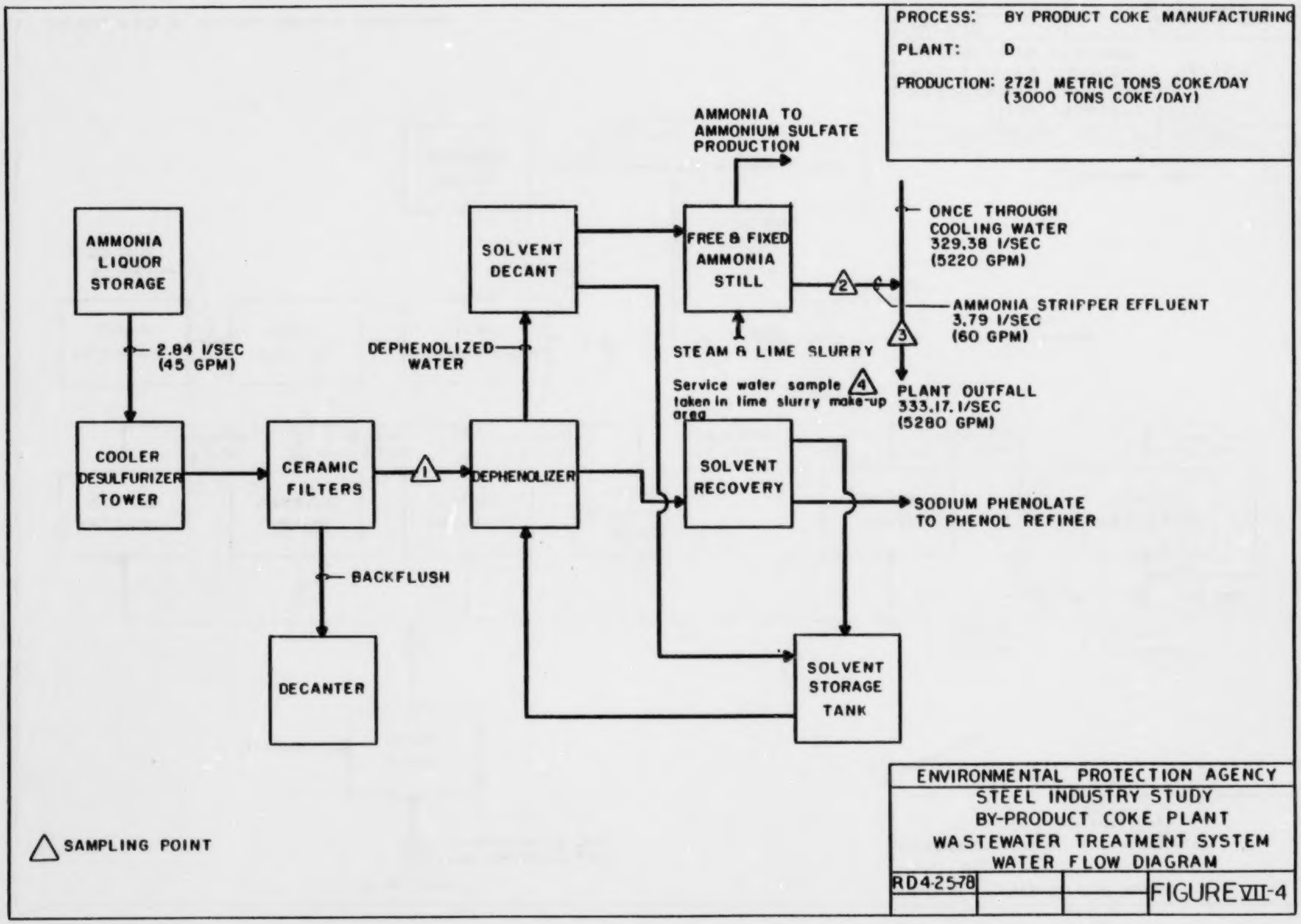
FIGURE VII-2



PROCESS: BY PRODUCT COKE MANUFACTURING
PLANT: C
PRODUCTION: 5399.4 METRIC TONS COKE/DAY
(5953 TONS COKE/DAY)
FRESH WATER MAKE-UP
4
QUENCH STATION N° 2
5
43.5 l/SEC (690 GPM)
WHARF
COKE
SETTLING BASIN
WASTE AMMONIA LIQUOR
1
8.5 l/SEC (135 GPM)
PHENOLIZED LIGHT OILS
PHENOL REMOVAL
NaOH
CAUSTIC SCRUBBER FORMS SODIUM PHENOLATE
SODIUM PHENOLATE
DEPHENOLIZED LIQUOR
LIGHT OILS
NH_3 TO ABSORBER
FREE LEG
LIME
NH_3
LIME
FIXED LEG
STEAM
AMMONIA STILL
FINAL COOLER BLOWDOWN
LIGHT OIL RECOVERY WASTE WATERS
QUENCH STATION N° 1 & 3
3
38.8 l/SEC EACH (615 GPM) EACH
WHARF
COKE
SETTLING BASIN
CaO
LIME SETTLING BASIN DETENTION TIME 2.5 HRS.
TREATED EFFLUENT TO SANITARY AUTHORITY
2
10.6 l/SEC (168 GPM)
△SAMPLING POINT
RD4-26-78

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY PRODUCT COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-3


AMMONIA LIQUOR STORAGE
2.84 l/SEC (45 GPM)
COOLER DESULFURIZER TOWER
CERAMIC FILTERS
BACKFLUSH
DECANTER
1
DEPHENOLIZER
DEPHENOLIZED WATER
SOLVENT DECANT
FREE & FIXED AMMONIA STILL
AMMONIA TO AMMONIUM SULFATE PRODUCTION
STEAM & LIME SLURRY
Service water sample taken in lime slurry make-up area
4
2
ONCE THROUGH COOLING WATER 329.38 l/SEC (5220 GPM)
AMMONIA STRIPPER EFFLUENT 3.79 l/SEC (60 GPM)
3
PLANT OUTFALL 333.17 l/SEC (5280 GPM)
SOLVENT RECOVERY
SODIUM PHENOLATE TO PHENOL REFINER
SOLVENT STORAGE TANK
SAMPLING POINT

PROCESS: BY PRODUCT COKE MANUFACTURING

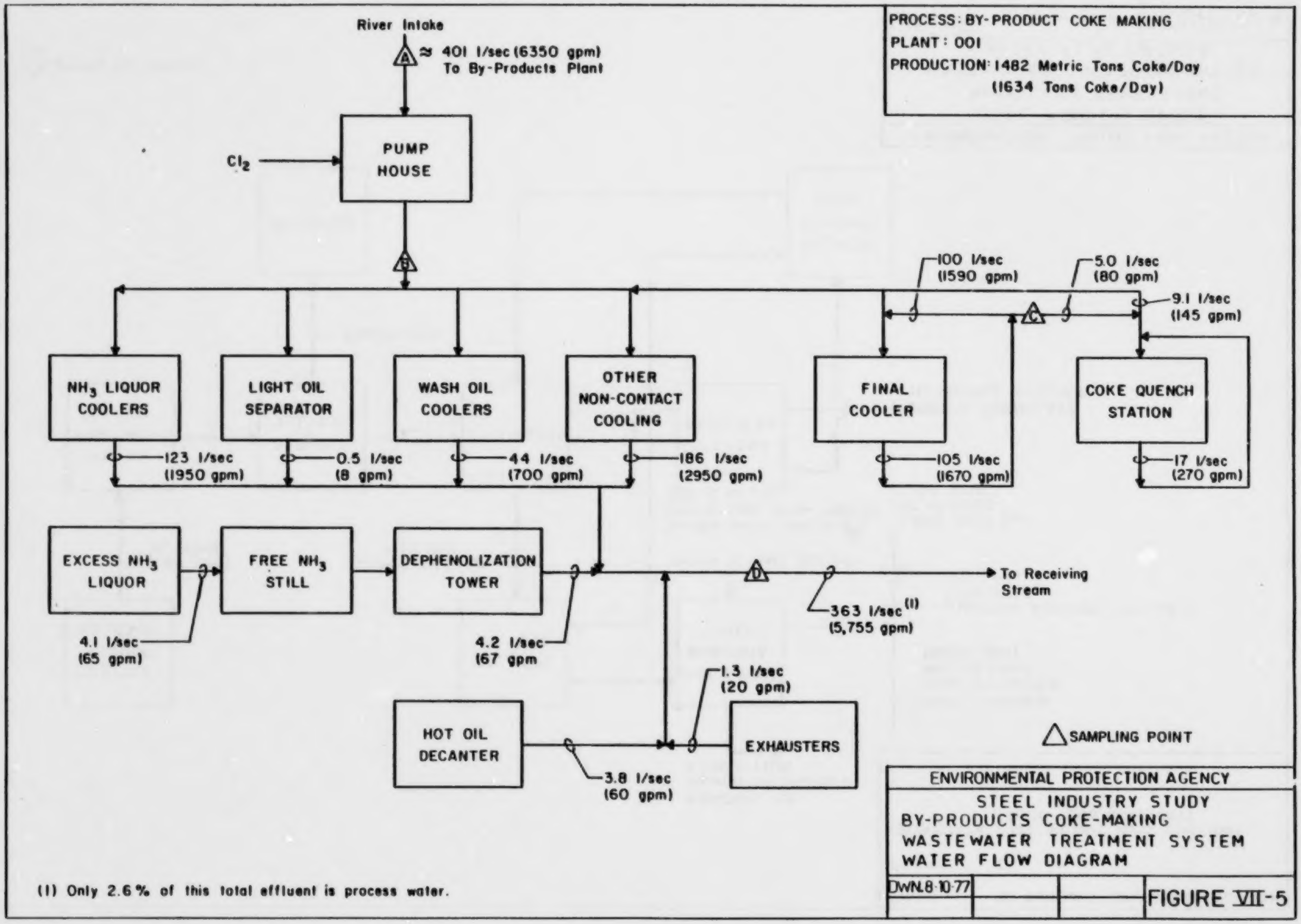
PLANT: D

PRODUCTION: 2721 METRIC TONS COKE/DAY
(3000 TONS COKE/DAY)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCT COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

RD 4-25-78

FIGURE VII-4


River Intake
A
≈ 401 l/sec (6350 gpm) To By-Products Plant
Cl_2
PUMP HOUSE
B
NH_3 LIQUOR COOLERS
LIGHT OIL SEPARATOR
WASH OIL COOLERS
OTHER NON-CONTACT COOLING
FINAL COOLER
COKE QUENCH STATION
123 l/sec (1950 gpm)
0.5 l/sec (8 gpm)
44 l/sec (700 gpm)
186 l/sec (2950 gpm)
105 l/sec (1670 gpm)
17 l/sec (270 gpm)
100 l/sec (1590 gpm)
C
5.0 l/sec (80 gpm)
9.1 l/sec (145 gpm)
EXCESS NH_3 LIQUOR
FREE NH_3 STILL
DEPHENOLIZATION TOWER
4.1 l/sec (65 gpm)
4.2 l/sec (67 gpm
D
363 l/sec(1) (5,755 gpm)
To Receiving Stream
HOT OIL DECANTER
EXHAUSTERS
1.3 l/sec (20 gpm)
3.8 l/sec (60 gpm)
SAMPLING POINT

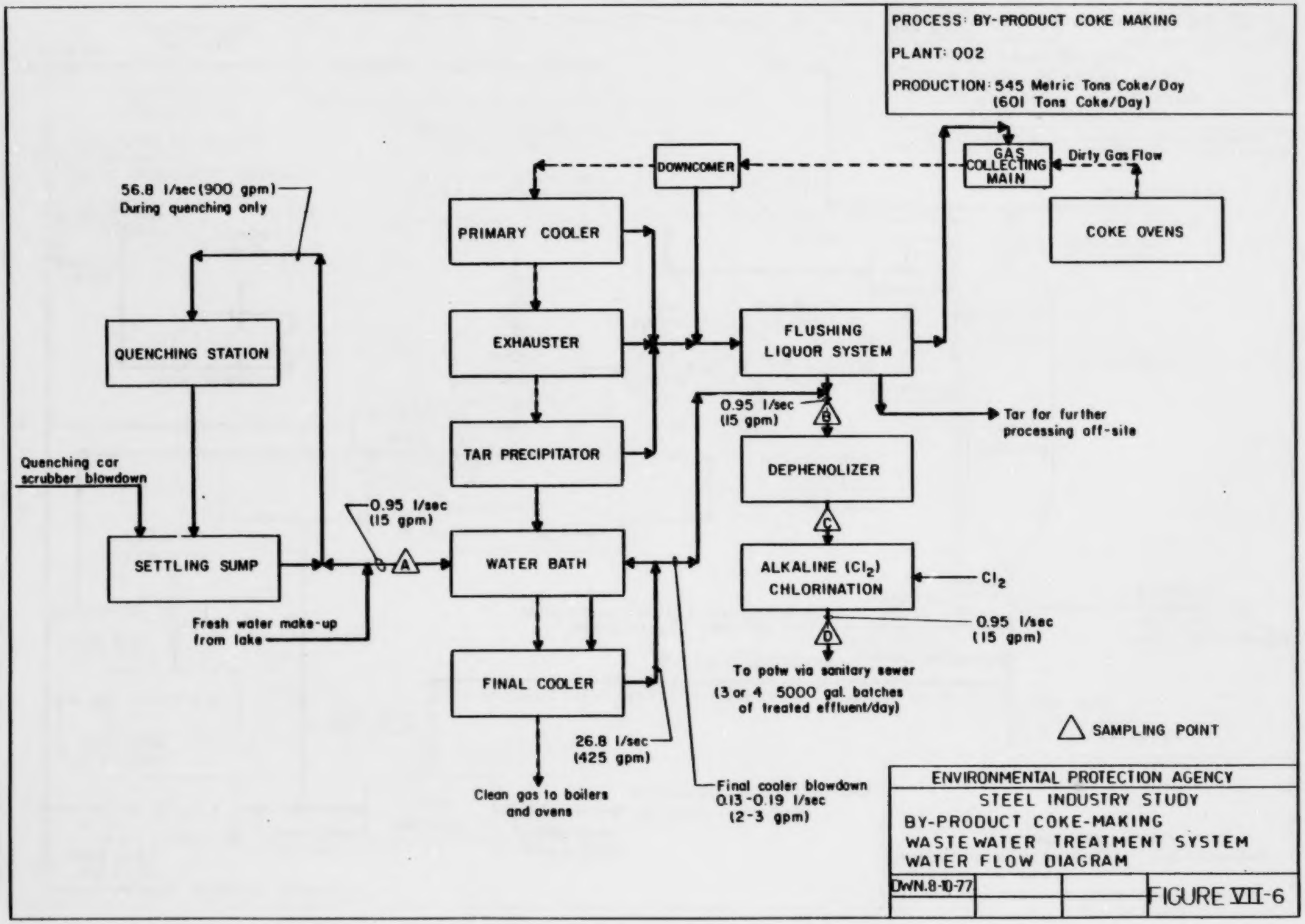
PROCESS: BY-PRODUCT COKE MAKING
PLANT: 001
PRODUCTION: 1482 Metric Tons Coke/Day
(1634 Tons Coke/Day)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCTS COKE-MAKING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

DWN.8·10·77

FIGURE VII-5

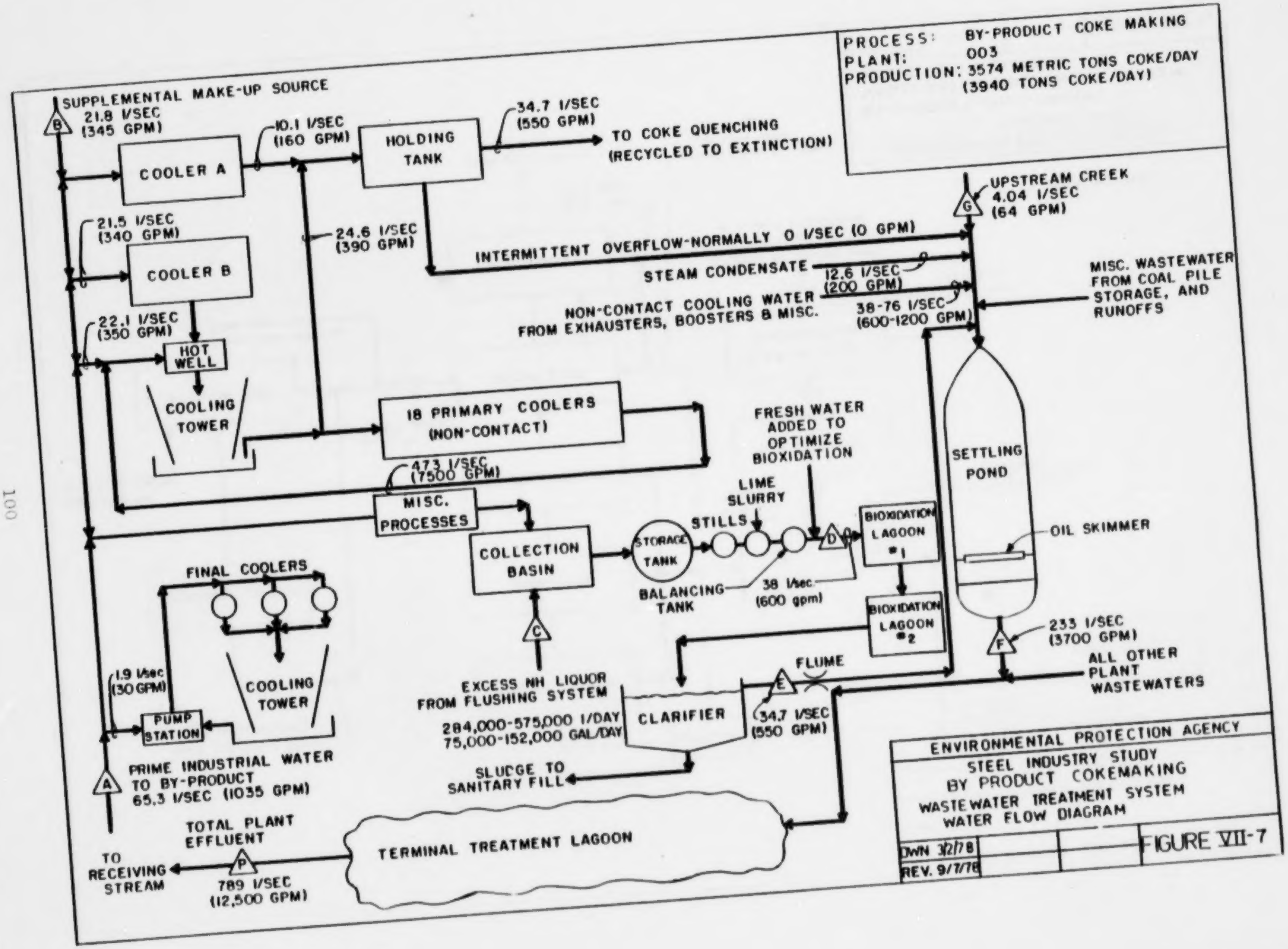
(1) Only 2.6% of this total effluent is process water.


PROCESS: BY-PRODUCT COKE MAKING
PLANT: 002
PRODUCTION: 545 Metric Tons Coke/Day (601 Tons Coke/Day)
COKE OVENS
Dirty Gas Flow
GAS COLLECTING MAIN
DOWNCOMER
56.8 l/sec (900 gpm) During quenching only
QUENCHING STATION
PRIMARY COOLER
EXHAUSTER
TAR PRECIPITATOR
FLUSHING LIQUOR SYSTEM
Tar for further processing off-site
0.95 l/sec (15 gpm)
B
DEPHENOLIZER
C
ALKALINE (Cl_2) CHLORINATION
Cl_2
0.95 l/sec (15 gpm)
D
To potw via sanitary sewer (3 or 4 5000 gal. batches of treated effluent/day)
Quenching car scrubber blowdown
SETTLING SUMP
0.95 l/sec (15 gpm)
A
WATER BATH
Fresh water make-up from lake
FINAL COOLER
26.8 l/sec (425 gpm)
Clean gas to boilers and ovens
Final cooler blowdown 0.13-0.19 l/sec (2-3 gpm)
△ SAMPLING POINT

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCT COKE-MAKING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

DWN. 8-10-77

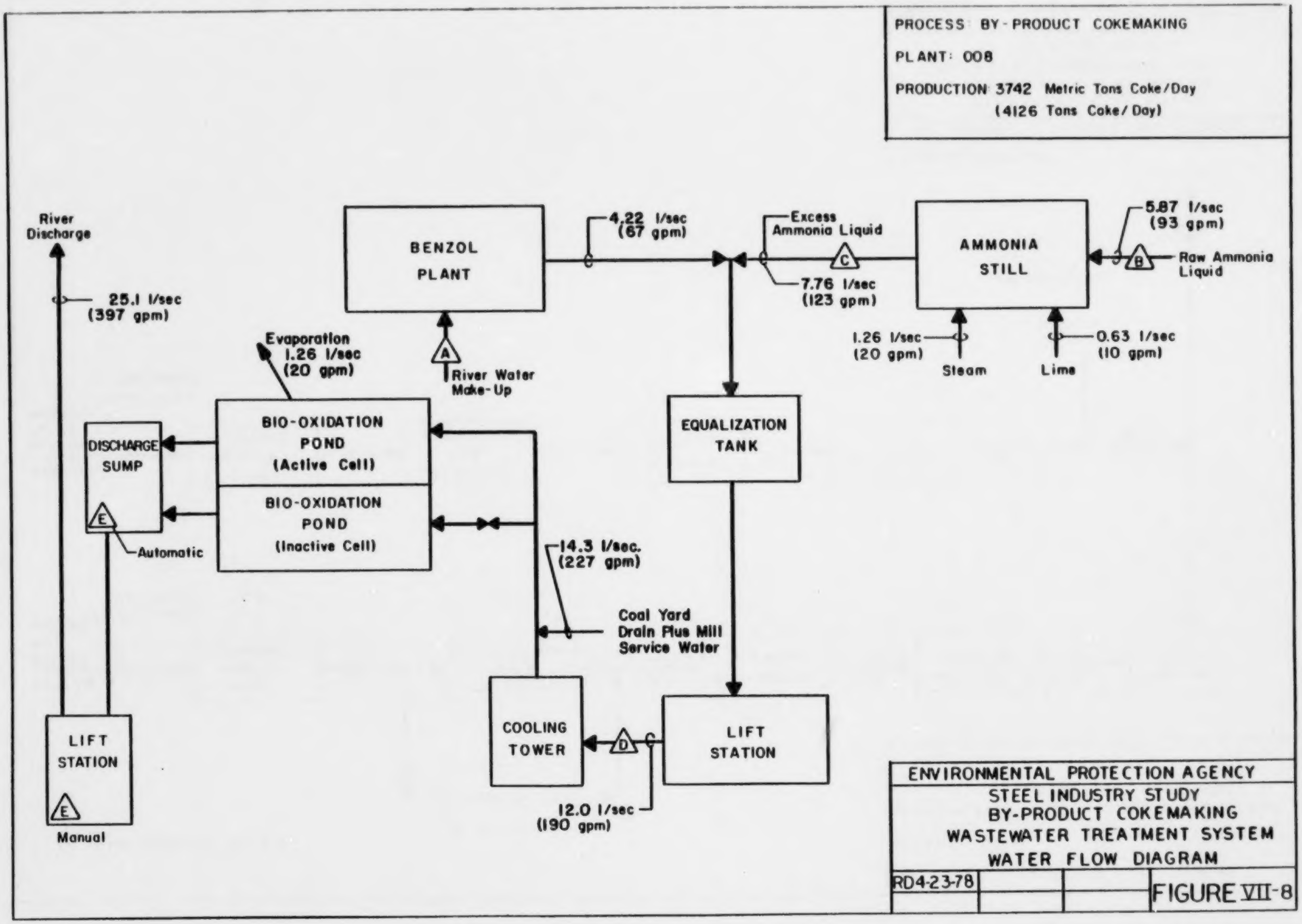
FIGURE VII-6


PROCESS: BY-PRODUCT COKE MAKING
PLANT: 003
PRODUCTION: 3574 METRIC TONS COKE/DAY
(3940 TONS COKE/DAY)
SUPPLEMENTAL MAKE-UP SOURCE
B
21.8 l/SEC
(345 GPM)
COOLER A
10.1 l/SEC
(160 GPM)
HOLDING TANK
34.7 l/SEC
(550 GPM)
TO COKE QUENCHING
(RECYCLED TO EXTINCTION)
21.5 l/SEC
(340 GPM)
COOLER B
24.6 l/SEC
(390 GPM)
22.1 l/SEC
(350 GPM)
HOT WELL
COOLING TOWER
18 PRIMARY COOLERS
(NON-CONTACT)
473 l/SEC
(7500 GPM)
MISC. PROCESSES
UPSTREAM CREEK
G
4.04 l/SEC
(64 GPM)
INTERMITTENT OVERFLOW-NORMALLY 0 l/SEC (0 GPM)
STEAM CONDENSATE
12.6 l/SEC
(200 GPM)
NON-CONTACT COOLING WATER
FROM EXHAUSTERS, BOOSTERS & MISC.
38-76 l/SEC
(600-1200 GPM)
MISC. WASTEWATER
FROM COAL PILE
STORAGE, AND
RUNOFFS
SETTLING POND
OIL SKIMMER
FRESH WATER
ADDED TO
OPTIMIZE
BIOXIDATION
LIME SLURRY
STILLS
COLLECTION BASIN
STORAGE TANK
BALANCING TANK
38 l/sec.
(600 gpm)
D
BIOXIDATION LAGOON #1
BIOXIDATION LAGOON #2
233 l/SEC
(3700 GPM)
F
ALL OTHER
PLANT
WASTEWATERS
FINAL COOLERS
COOLING TOWER
1.9 l/sec
(30 GPM)
PUMP STATION
C
EXCESS NH LIQUOR
FROM FLUSHING SYSTEM
284,000-575,000 l/DAY
75,000-152,000 GAL/DAY
CLARIFIER
FLUME
E
34.7 l/SEC
(550 GPM)
SLUDGE TO
SANITARY FILL
A
PRIME INDUSTRIAL WATER
TO BY-PRODUCT
65.3 l/SEC (1035 GPM)
TOTAL PLANT
EFFLUENT
TERMINAL TREATMENT LAGOON
P
TO
RECEIVING
STREAM
789 l/SEC
(12,500 GPM)
DWN 3/2/78
REV. 9/7/78

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY PRODUCT COKEMAKING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-7

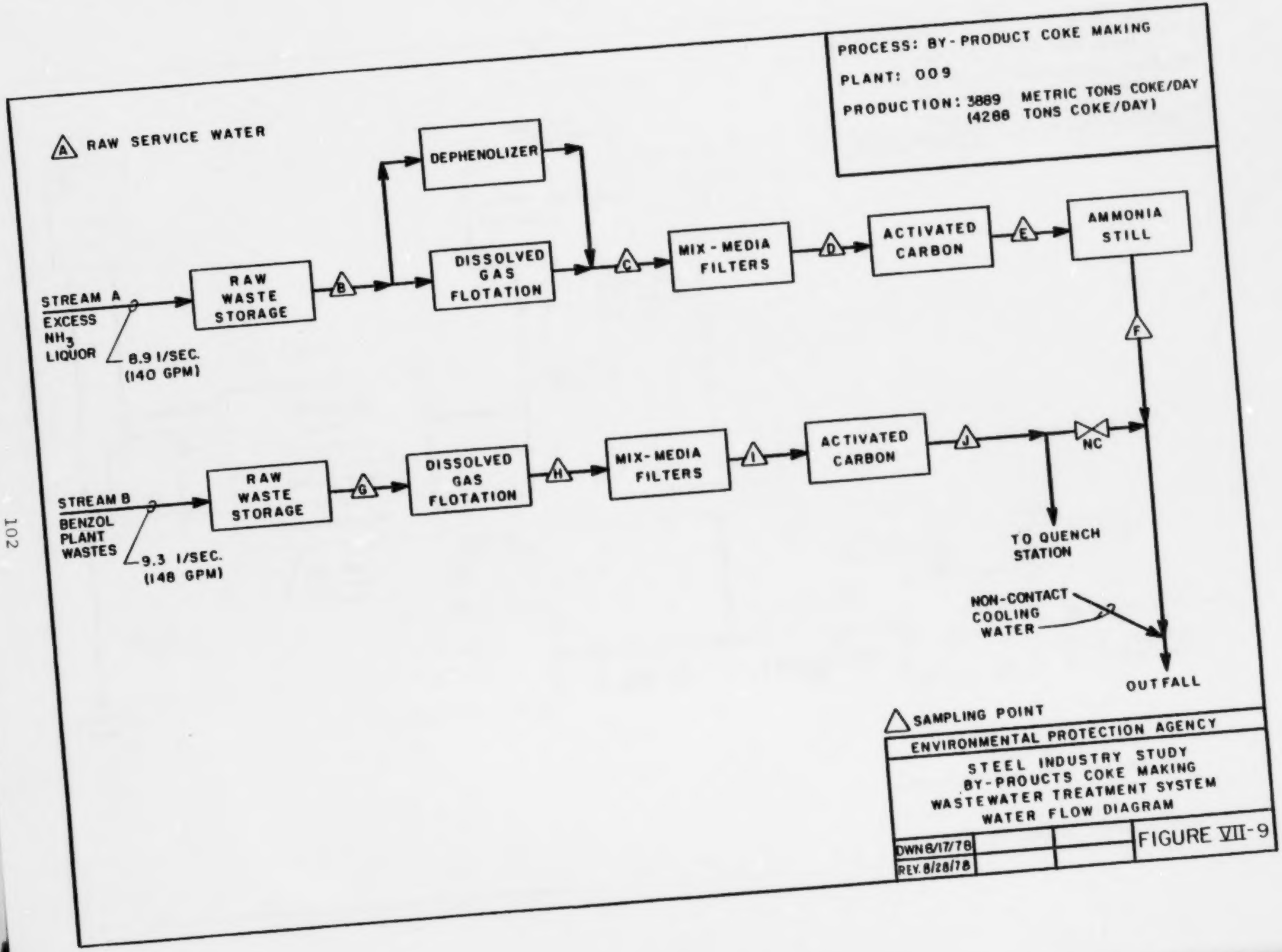
PROCESS: BY-PRODUCT COKEMAKING
PLANT: 008
PRODUCTION: 3742 Metric Tons Coke/Day
(4126 Tons Coke/Day)



BENZOL PLANT
4.22 l/sec (67 gpm)
Excess Ammonia Liquid
C
7.76 l/sec (123 gpm)
AMMONIA STILL
5.87 l/sec (93 gpm)
B
Raw Ammonia Liquid
1.26 l/sec (20 gpm)
Steam
Lime
0.63 l/sec (10 gpm)
A
River Water Make-Up
EQUALIZATION TANK
LIFT STATION
D
12.0 l/sec (190 gpm)
COOLING TOWER
Coal Yard Drain Plus Mill Service Water
14.3 l/sec. (227 gpm)
BIO-OXIDATION POND (Active Cell)
BIO-OXIDATION POND (Inactive Cell)
Evaporation 1.26 l/sec (20 gpm)
DISCHARGE SUMP
E
Automatic
LIFT STATION
E
Manual
River Discharge
25.1 l/sec (397 gpm)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCT COKEMAKING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM
RD4-23-78

FIGURE VII-8


PROCESS: BY-PRODUCT COKE MAKING
PLANT: 009
PRODUCTION: 3889 METRIC TONS COKE/DAY (4288 TONS COKE/DAY)
A RAW SERVICE WATER
STREAM A
EXCESS NH_3 LIQUOR
8.9 l/SEC. (140 GPM)
RAW WASTE STORAGE
B
DEPHENOLIZER
DISSOLVED GAS FLOTATION
C
MIX-MEDIA FILTERS
D
ACTIVATED CARBON
E
AMMONIA STILL
F
STREAM B
BENZOL PLANT WASTES
9.3 l/SEC. (148 GPM)
RAW WASTE STORAGE
G
DISSOLVED GAS FLOTATION
H
MIX-MEDIA FILTERS
I
ACTIVATED CARBON
J
NC
TO QUENCH STATION
NON-CONTACT COOLING WATER
OUTFALL
SAMPLING POINT
DWN 6/17/78
REV. 8/28/78

ENVIRONMENTAL PROTECTION AGENCY

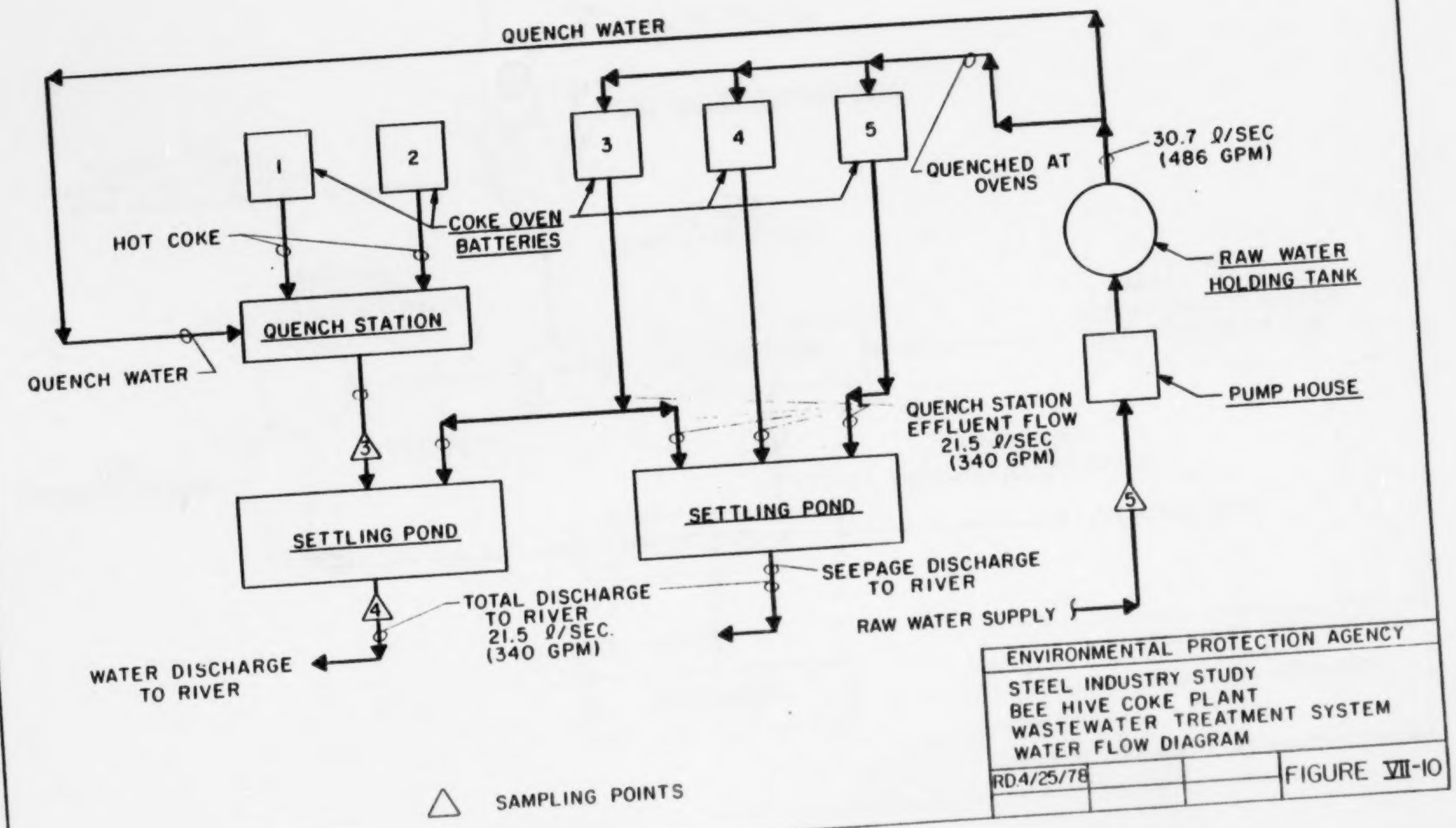
STEEL INDUSTRY STUDY
BY-PROUCTS COKE MAKING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-9

PROCESS: BEE HIVE COKE MANUFACTURING

PLANT: E

PRODUCTION: 907 METRIC TONS COKE PER DAY (1000 TONS COKE PER DAY)


QUENCH WATER
1
2
3
4
5
HOT COKE
COKE OVEN BATTERIES
QUENCHED AT OVENS
30.7 ℓ/SEC (486 GPM)
RAW WATER HOLDING TANK
QUENCH STATION
QUENCH WATER
PUMP HOUSE
QUENCH STATION EFFLUENT FLOW 21.5 ℓ/SEC (340 GPM)
3
5
SETTLING POND
SETTLING POND
SEEPAGE DISCHARGE TO RIVER
TOTAL DISCHARGE TO RIVER 21.5 ℓ/SEC. (340 GPM)
4
RAW WATER SUPPLY
WATER DISCHARGE TO RIVER

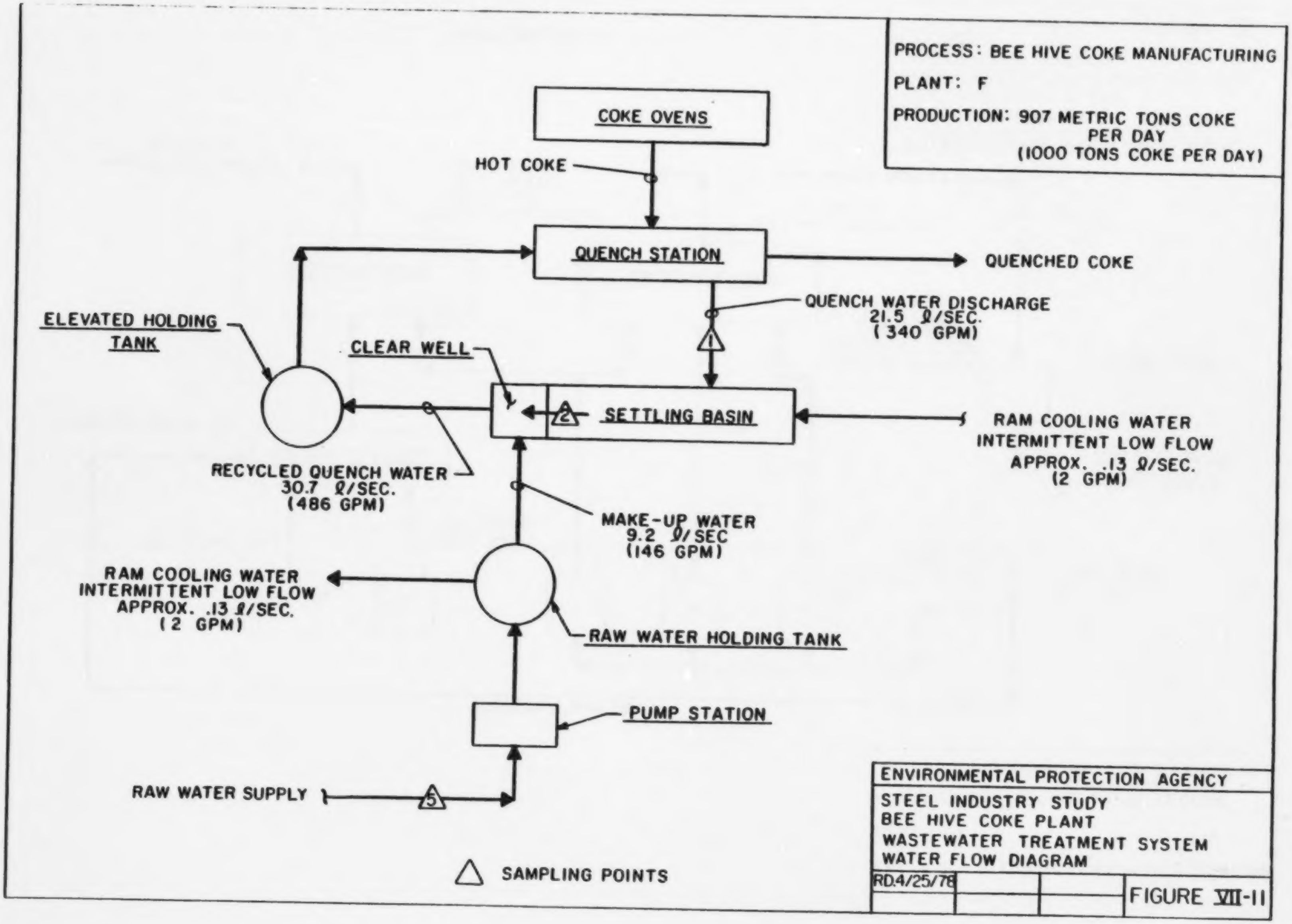
△ SAMPLING POINTS

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BEE HIVE COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

RD4/25/78

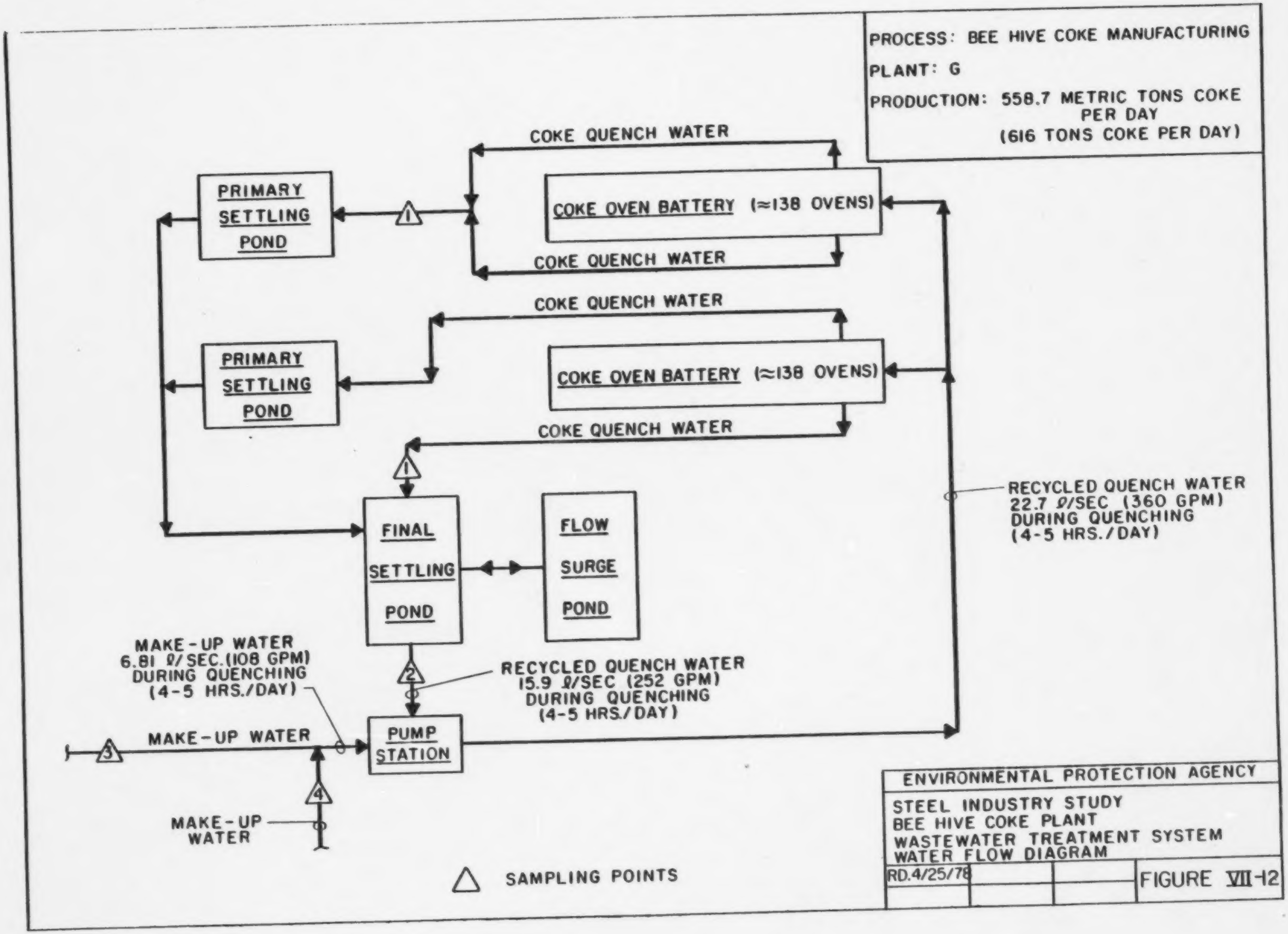
FIGURE VII-10


COKE OVENS
HOT COKE
QUENCH STATION
QUENCHED COKE
QUENCH WATER DISCHARGE
21.5 ℓ/SEC.
(340 GPM)
1
ELEVATED HOLDING TANK
CLEAR WELL
2
SETTLING BASIN
RAM COOLING WATER
INTERMITTENT LOW FLOW
APPROX. .13 ℓ/SEC.
(2 GPM)
RECYCLED QUENCH WATER
30.7 ℓ/SEC.
(486 GPM)
MAKE-UP WATER
9.2 ℓ/SEC
(146 GPM)
RAM COOLING WATER
INTERMITTENT LOW FLOW
APPROX. .13 ℓ/SEC.
(2 GPM)
RAW WATER HOLDING TANK
PUMP STATION
RAW WATER SUPPLY
5
△ SAMPLING POINTS

PROCESS: BEE HIVE COKE MANUFACTURING
PLANT: F
PRODUCTION: 907 METRIC TONS COKE PER DAY
(1000 TONS COKE PER DAY)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BEE HIVE COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM
RD.4/25/78

FIGURE VII-11


COKE QUENCH WATER
PRIMARY SETTLING POND
1
COKE OVEN BATTERY (≈138 OVENS)
COKE QUENCH WATER
COKE QUENCH WATER
PRIMARY SETTLING POND
COKE OVEN BATTERY (≈138 OVENS)
COKE QUENCH WATER
1
RECYCLED QUENCH WATER
22.7 ℓ/SEC (360 GPM)
DURING QUENCHING
(4-5 HRS./DAY)
FINAL SETTLING POND
FLOW SURGE POND
MAKE-UP WATER
6.81 ℓ/SEC.(108 GPM)
DURING QUENCHING
(4-5 HRS./DAY)
2
RECYCLED QUENCH WATER
15.9 ℓ/SEC (252 GPM)
DURING QUENCHING
(4-5 HRS./DAY)
3
MAKE-UP WATER
PUMP STATION
4
MAKE-UP WATER
△ SAMPLING POINTS

PROCESS: BEE HIVE COKE MANUFACTURING
PLANT: G
PRODUCTION: 558.7 METRIC TONS COKE PER DAY
(616 TONS COKE PER DAY)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BEE HIVE COKE PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM
RD.4/25/78
FIGURE VII-12

COKEMAKING SUBCATEGORY

SECTION VIII

COST, ENERGY, AND NON-WATER QUALITY IMPACTS

Introduction

This section presents the estimated costs of applying the various alternative wastewater treatment systems. The analysis also considers the energy requirements and non-water quality impacts (including sludge disposal and by-product recovery) associated with compliance with the promulgated BPT, BAT, BCT, NSPS, PSES, and PSNS limitations and standards.

All of the basic components of the various model treatment systems are presently in use. In addition, as there are many possible combinations and variations of the treatment systems available which may be used to achieve the limitations and standards, not all plants will be required to add all of the treatment system components (or incur all of the incremental costs indicated) to bring facilities into compliance with the limitations and standards. Estimates of the capital investment required to bring all by-product and beehive coke plants into compliance with the BPT and BAT limitations are presented in this section.

Comparison of Industry Costs and EPA Model Costs

The water pollution control costs reported for plants visited during this study are presented in Tables VIII-1 and VIII-2 for by-product and beehive operations, respectively. The individual treatment systems, gross effluent loads, and reductions achieved are described in Section VII. The Agency determined actual industry costs from data supplied for the plants (all costs converted to July 1978 dollars). Standard cost of capital and depreciation percentages were used so that these basic costs would be comparable from plant to plant.

In general, the costs varied primarily with increasing sophistication of treatment systems, and less with the size of the treatment system. Annual costs for three biological oxidation plants (B, 003, and 008) are lower than those for physical/chemical systems, especially for energy and chemicals.

Table VIII-3 provides a comparison of actual industry costs vs EPA estimated costs for facilities in-place at seven biological and five physical/chemical plants. Footnotes to Table VIII-3 provide information relating to factors which contribute to the cost differences observed. For some plants, some of the wastewaters are disposed of by coke quenching, thus minimizing the volume of wastewaters requiring treatment. Overall, model-based estimates are within 4% of the industry's capital costs and 13% lower than the

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industry's annual costs. The Agency concludes that its model-based estimates accurately reflect actual costs incurred by the industry. As a whole, cost estimates based upon models are sufficiently generous to cover initial investment costs including land acquisition and clearing, retrofitting new systems to old production facilities, and other site specific costs as well as the cost of capital equipment.

For beehive operations, capital and annual costs reported for three plants proved to be a small fraction of model-based estimates, primarily because the model includes a standard allowance for roadways, fencing and buildings associated with wastewater treatment, while the actual beehive plants either do not have such components or such costs were not reported. For beehive operations, the wastewater treatment components could usually be provided at low cost. For example, at plant E a settling basin was installed for less than $7,000 by using the natural contours of their site and a small earthen dike. The model estimate for the basin, including site preparation and excavation, would be about $36,000. In every case, model costs are at least four times greater than actual plant cost for beehive cokemaking operations.

Control and Treatment Technology (C&TT) Considered for Use in Cokemaking Operations

The control and treatment technology (C&TT) in use or available for use for cokemaking operations is presented in Table VIII-4. It should be recognized that this regulation does not require the installation of these C&TT steps. Any other alternative treatment system which achieves the limitations are acceptable. In addition to listing the treatment methods available, Table VIII-4 also presents the following information:

1. Description
2. Implementation time
3. Land requirements

The levels of treatment, their respective costs, the pollutants removed, and the energy requirements and non-water quality impacts associated with those levels of treatment are discussed below.

A. Treatment Costs

1. BPT Effluent Limitations

a. By-Product Cokemaking Operations

Reference is made to Section IX for identification of the model BPT treatment system. Certain steps which result in the reduction of pollutants in the wastewater are commonly practiced for the purpose of by-product recovery, and thus are not considered wastewater treatment technologies. Accordingly, these steps are not costed as wastewater treatment systems. Free ammonia stripping and dephenolization of the raw wastewaters fit this description, since their primary aim is the recovery of ammonium salts and sodium phenolates. Refer to Table VIII-5 for BPT model treatment component costs.

The Agency has calculated costs for facilities in-place at each by-product cokemaking plant, and has estimated the costs of the model system components which are required to achieve the BPT limitations. The Agency identified the wastewater treatment facilities at two plants (0684F and 0732A) as advanced physical/chemical systems because of the presence of key components (full scale activated carbon systems) while all other plants have been costed with biological treatment systems. The Agency believes the estimated BPT costs are accurate on the basis of the favorable cost comparisons shown in Table VIII-3. Table VIII-11 presents the Agency's estimates of industry-wide capital and annual costs required to achieve the BPT limitations for cokemaking operations.

b. Beehive Cokemaking Operations

The model BPT treatment system consists of collecting all quenchwater runoffs in a settling pond, and then recycling all pond overflows to the quenching station. A "no discharge" condition results. The Agency estimates that no additional expenditures are required for beehive cokemaking operations to achieve compliance with the BPT limitation.

2. BAT limitations

a. By-Product Cokemaking Operations

Reference is made to Section X for identification of the model BAT treatment system. The initial capital investment and annual operating costs for a typical 4700 TPD iron and steel by-product coke plant are shown in Table VIII-6 and for a typical 1690 TPD merchant coke plant in Table VIII-7. Model plant costs for each BAT alternative considered by the Agency are also presented in Tables VIII-6 and VIII-7. Table VIII-8 presents similar data for physical-chemical cokemaking operations. Table VIII-11 presents industry-wide cost data for iron and steel coke plants and merchant coke plants, respectively, for the model BAT treatment system selected as the basis for the BAT limitations.

b. Beehive Cokemaking Operations

Since the BPT limitation of no discharge of process wastewater pollutants has been achieved at beehive coke plants, additional technologies and investment and operating costs are not required.

3. BCT Limitations

a. By-Product Cokemaking Operations

Section 304(b)(4) of the Act requires that certain "conventional" pollutants be controlled by BCT limitations. The "conventional" pollutants limited by the BPT limitations for by-product cokemaking are suspended solids, oil and grease, and pH. Since the BPT and BCT limitations are the same, there are no BCT costs for cokemaking operations.

b. Beehive Cokemaking Operations

Since zero discharge is the BPT limitation for beehive cokemaking operations, the BCT limitation is also zero discharge and there are no BCT costs.

4. NSPS

a. By-Product Cokemaking Operations

Model treatment system costs have been developed for three NSPS alternatives which are similar to those considered for BAT. Advanced biological treatment the same as that considered for BAT is the model NSPS technology. Refer to Table VIII-9 for NSPS model costs covering by-product cokemaking. Since this study does not include projections of industry capacity additions, industry-wide new source costs are not presented here.

b. Beehive Cokemaking Operations

No NSPS costs were developed for beehive cokemaking operations.

5. Pretreatment Standards

a. By-Product Cokemaking Operations

Six alternative treatment systems were considered for pretreatment standards for existing and new sources. Costs for these alternatives are presented in Table VIII-10. Industry wide costs for the promulgated PSES are presented in Table VIII-11.

b. Beehive Cokemaking Operations

As noted earlier, since the remaining beehive cokemaking operation is located in an area remote from POTWs, and it is very unlikely that any new beehive operations will be built, the Agency has not promulgated PSES or PSNS for beehive cokemaking operations and has not developed the respective model treatment system costs.

B. Summary of Pollutant Load Reductions

Refer to Volume I, Appendix C of this Development Document for summaries of costs and effluent quality data for iron and steel, merchant, and beehive cokemaking operations, respectively. The annual tons of the various pollutants removed from cokemaking wastewaters by complying with the BPT and BAT limitations and with PSES are also shown in Appendix C of Volume I.

C. Energy Requirements

The various levels of treatment for cokemaking wastewaters all consume relatively low amounts of energy, mostly at the BPT level.

1. Energy Impact at BPT/BCT

The Agency estimates that installing and operating the BPT model treatment systems at all cokemaking operations will consume 58.2 million kwh of electricity per year. This total includes 49.6 million kwh for treatment at 31 iron and steel plants, 8.3 million kwh for treatment at 11 merchant plants, and 0.3 million kwh for treating wastewaters at the single operating beehive cokemaking plant. This consumption represents 0.1% of the 57 billion kwh consumed by the entire steel industry in 1978, a relatively insignficant impact.

2. Energy Impact at all BAT Levels

Additional treatment components must be added to upgrade the BPT model treatment systems to the BAT model treatment systems. The additional energy requirements for each BAT alternative are shown in Table VIII-12. The additional energy requirements for the most energy intensive alternative would be less than 0.1% of total industry power consumption.

No additional energy is required to comply with the BAT limitations for beehive cokemaking operations.

3. Energy Impacts at NSPS, PSNS, and PSES

Since NSPS model treatment systems are based upon technologies essentially identical to a combination of the proposed BPT and BAT/BCT model treatment systems their requirements are equivalent to the sum of the proposed BPT and BAT model requirements. Some minor amounts of energy can be saved by incorporating flow reduction at the earliest possible level, thus reducing some equipment size and cost.

The estimated energy requirements for NSPS alternatives are based upon a 4700 ton per day iron and steel plant model size or a 1690 ton per day merchant plant model size operating 365 days per year. NSPS Alternative 1 would require 2.8 million kwh for iron and steel plants, or 1.2 million kwh for merchant plants. Alternatives 2 and 3 would consume varying additional amounts. For PSES and PSNS, model plant sizes of 4,700 tons per day for iron and steel plants and 920 tons per day for merchant plants formed the basis for all estimates. PSES Alternative 1 consumes 4.96 million kwh at 8 iron and steel plants, and 1.33 million kwh per year for 8 merchant plants. PSNS Alternative 1 would consume 0.62 million kilowatt-hours/year for iron and steel model-sized plants, and 0.30 million kwh for merchant plants.

The Agency believes that the pollution control benefits described outweigh adverse impacts associated with the increased energy consumption described.

D. Non-water Quality Impacts

1. Air Pollution

Certain treatment steps in the BPT model treatment system are designed to return additional amounts of ammonia, hydrogen sulfide and hydrogen cyanide to the coke oven gas. If careful control of collectors, ductwork and piping is not practiced, some of these gases could escape to the atmosphere. In the biological treatment steps, a potential for odor exists if the biomass is not properly maintained. Systems which depend on incineration either by controlled combustion or recycle to extinction over quench towers (such as BAT Alternative 4) generate significant particulate carryover from high concentrations of dissolved solids in the wastewaters. These solids precipitate and disperse over wide areas, even if the wastewaters are pretreated to remove regulated pollutants prior to evaporation. The Agency concludes that the effluent reduction benefits associated with compliance with the limitations and standards justify any minor adverse air impacts that may result.

2. Solids Waste Disposal

The use of lime to raise pH levels prior to fixed ammonia stripping can produce 10 to 12 tons of sludge per day per plant in the form of unreacted calcium hydroxide, along with precipitated calcium carbonates and sulfates. The disposal of these sludges will impose costs, and care must be taken to prevent sludges from redissolving and entering streams as runoff from landfill sites. Sludges should be recycled where practical to consume as much as possible in process reactions. Lesser amounts of sludges are formed when caustic soda is used as the alkali, but caustic soda is more expensive than lime and the resultant dissolved solids discharge will be higher. Other sludges resulting from water treatment include coal or coke fines which are readily recycled to coke ovens. Also, the biological treatment systems generate some bacteriological sludges which require periodic disposal. Some plants, e.g., Plant B, transfer such sludges to a local POTW at very low flows (1 gpm), while others landfill these sludges along with sediment from settling ponds.

Relatively little additional impact in the form of solid wastes results from application of the BAT alternative treatment systems. Small amounts of additional sludges will form, but will be only a fraction of those generated for disposal by the BPT model treatment system. These solids must be properly disposed of, and are subject to regulations under other applicable statutes. However, their environmental impacts are lessened by separating them from wastewater and controlling their disposal on land. A summary of the solid wastes generated by cokemaking operations is presented in Table VIII-13. The Agency does not consider recovered ammonium sulfate as solid waste due to wastewater treatment even though, at times, this material cannot be readily sold due to unfavorable market conditions.

E. Costs of Retrofit for Existing Plants

In addition to the cost comparison reported above and in Table VIII-3, the Agency attempted to isolate the actual costs expended to retrofit process wastewater treatment systems to existing production facilities. Nine coke plants were selected to provide detailed installation costs. Respondents were asked to itemize costs which would not have been incurred if treatment systems were installed simultaneously with construction, replacement or expansion of production facilities. Of the nine plants solicited, two provided no cost data, three replied that there were no retrofit costs applicable to their treatment systems, three reported retrofit costs of 2.7% to 6.9% of their total treatment plant costs, and one cited costs at 13.4% of total cost. These latter, higher percentage costs reflected the dismantling, relocation, and reassembly of a benzol plant. While this may have been necessary in this particular case to provide space for building a wastewater treatment plant, the cost of benzol plant reassembly is more correctly characterized as a process cost. If reassembly were backed out of retrofit cost for this site, the remaining retrofit items are 7.7% of treatment plant installation costs. The estimated on-site costs based upon treatment plant model costs compare favorably with total actual costs reported by those plants solicited, including three of the four which provided retrofit cost data. After comparing these data, the Agency concludes its cost estimates based upon the model plants are sufficiently generous to cover all normal retrofit costs. For most plants, the Agency believes that retrofit costs will be a small fraction of total investment cost.

F. Water Consumption

The need to minimize flows by recycle of final cooler water and crystallizer barometric condenser water will have only minor impact on water consumption at by-product cokemaking operations. Water consumption attributable to wastewater treatment is estimated to increase to a total of 0.85 million gallons per day when all plants achieve the BPT limitations and to 1.09 million gallons per day when the BAT limitations are achieved. These losses are minor compared with the 22.6 million gallons currently evaporated at coke quench stations on a typical production day. Based upon these factors, the Agency concludes that the water consumption losses, on a nationwide basis, are justified when compared with the effluent reduction benefits attributable to compliance with the BPT and BAT limitations and PSES.

The Agency also evaluated whether the establishment of a subdivision for plants located in arid or semi-arid regions was warranted. It found that the water loss for those plants is the same as for plants in other areas of the country. Moreover, the plants in water-short regions (0196A, 0448A, 0492A, and 0864A) continue to use wet quenching stations, even though dry quenching technology is available and is currently practiced in other countries. The wet cooling towers at plants located in arid and semi-arid regions consume about 1 million gallons per day, which is 35 times the amount which will be consumed by complying with the BPT and BAT limitations. In complying with the BPT and BAT limitations, however, thousands of pounds of pollutants will not be discharged. Based on these factors and those discussed in Volume I of this Development Document, the Agency concludes that the amount of water which will be consumed by plants located in arid and semi-arid regions is justified when compared to the effluent reduction benefits, and that establishing a subdivision with alternative, less stringent effluent limitations for those plants is not warranted.

Summary of Impacts

The Agency concludes that the effluent reduction benefits described below for the cokemaking subcategory outweigh the adverse impacts associated with energy consumption, air pollution, solid waste disposal, and water consumption.

Effluent Loadings (Tons/Year)

	Raw Waste	BPT	BAT	PSES
Flow, MGD	32.5	33.3	22.7	4.8
TSS	2,480	3,340	2,280	724
Oil and Grease	3,713	405	173	109
Ammonia (N)	29,710	3,800	242	434
Total Cyanide	2,480	253	86	116
Phenols (4AAP)	14,853	25	0.6	261
Toxic Organics	5,812	138	25	208
Toxic Metals	129	35	24	11
Other Pollutants	31,190	152	24	1,665

The Agency also concludes that the effluent reduction benefits associated with compliance with new source standards (NSPS, PSNS) outweigh the adverse energy and non-water quality environmental impacts.

TABLE VIII-1

EFFLUENT TREATMENT COSTS REPORTED BY THE INDUSTRY
BY-PRODUCT COKEMAKING

(All Costs Converted To 7/1/78 Dollars)

Plant Code Reference Code	A 0432B	B 0112	C 0384A	D 0272
Initial Investment	4,069,000	1,209,400	6,919,600	3,450,800
Annual Costs				
Capital	365,800	108,700	622,100	310,200
Oper. & Maint.	242,700	79,700	238,200	301,200
Energy, Chemicals, & Power	1,671,200	48,800	1,467,300	7,600
TOTAL ANNUAL	2,279,700	237,200	2,327,600	619,000
$/Ton	1.20	0.128	0.890	0.565
$/1000 Gallons Treated	12.44	1.24	12.33	13.15

Plant Code Reference Code	001 0732A	002 0464C	003 0868A	008 0920F	009 0684F
Initial Investment	977,400	No Cost Figures Reported By Plant	9,775,500	6,192,000	10,600,000
Annual Costs					
Capital	87,900		878,800	566,700	952,900
Oper. & Maint.	39,900		991,600	143,900	1,771,800
Energy, Chemicals, & Power	99,500		1,156,700	341,100	2,372,900
TOTAL ANNUAL	227,300		3,027,100	1,041,700	5,097,600
$/Ton	0.441		1.40	0.662	4.19
$/1000 Gallons Treated	3.01		14.39	4.83	57.24

TABLE VIII-2

EFFLUENT TREATMENT COSTS REPORTED BY THE INDUSTRY BEEHIVE COKEMAKING

(All Costs Converted to 7/1/78 Dollars)

Plant Code Reference Code	E 0428A	F 0428A	G 0724G
Initial Investment	$ 6,720	$12,600	$32,800
Annual Costs			
Capital	600	1,130	2,950
Oper. & Maint.	40,500	20,160	2,020
Energy & Power	0	0	1,140
TOTAL	$41,100	$21,290	$ 6,110
$/Ton	0.113	0.0584	0.0272
$/1000 Gal treated	0.230	0.119	0.221

TABLE VIII-3

COMPARISON OF COSTS FOR SURVEYED PLANTS (VISITS AND D-DCP'S) ESTIMATES BASED ON TREATMENT MODELS VERSUS ACTUAL PLANT COSTS (ALL COSTS CONVERTED TO 7/1/78 DOLLARS)

Plant Codes	Cost Reported By Industry		Cost Estimated From Models		% Difference In Costs		Notes
	Capital	Annual(1)	Capital	Annual	Capital	Annual	
A-0432B	4,069,000	2,279,700	4,241,300	1,348,000	+4.2	-40.9	(2),(5)
B-0112	1,209,400	237,200	1,546,800	460,200	+27.9	+94.0	(2),(3),(5)
C-0384A	6,919,600	2,327,600	5,235,000	1,645,800	-24.3	-29.3	(2),(4),(5)
D-0272	3,450,800	619,000	3,288,700	812,900	-4.7	+31.3	
003-0868A	9,775,500	3,027,100	8,114,500	2,289,300	-17.0	-24.4	
008-0920F	6,192,000	1,041,700	5,876,300	1,561,700	-5.1	+49.9	
009-0684F	10,600,000	5,097,600	7,976,700	2,609,000	-24.7	-48.8	(5),(6)
0012A	2,755,500	NR	3,646,700	880,100	+32.3	-	(2),(5)
0426	3,550,600	746,700	3,834,400	959,700	+8.0	+28.5	
0584F(B)	5,100,700	656,200	4,848,000	1,246,600	-4.9	+90.0	
0584F(M)	2,427,900	537,900	5,631,600	1,504,800	+132	+180	(2),(5),(8)
TOTALS	56,051,000	16,570,700	54,240,000	14,438,000(8)	-3.2	-12.9	

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(1) Standard depreciation and capital recovery factors were used to develop standard annualized cost of capital estimates. Actual plant operating and maintenance costs are included.

(2) Part of raw waste flow is treated. The remainder is discharged untreated, or disposed of via quenching.

(3) Dilution flow is excess of model dilution flow rates and added, resulting in some oversized equipment at plant.

(4) Indirect discharger. Costs are for pretreatment only.

(5) Partial ammonia stripping.

(6) Cokemaking wastewaters from an off-site cokemaking operation are treated at this plant.

(7) Wastewaters from plant M are partly treated in plant B, providing certain cost savings.

(8) Annual costs extimates for plant 0012A are not included. Actual annual costs were not reported for this plant.

NR: No annual cost data reported.

TABLE VIII-4

CONTROL AND TREATMENT TECHNOLOGIES
COKEMAKING SUBCATEGORY

C&TT Step	Description	Implementation Time (Months)	Land Usage (ft^2)	
			I&S	Merchant
I.	BY-PRODUCT COKEMAKING - ALL SYSTEMS:			
A	GAS FLOTATION (Final Cooler Blowdown and Benzol Plant Wastewaters Only) - Waste pickle liquor is used to break emulsions, and an inert gas mixture is introduced to enhance the separation of oils and greases by flotation.	8 to 10	1,200	400
B	LIME ADDITION - Wastewaters from Step A are mixed with waste ammonia liquor and miscellaneous process wastes, dephenolized (if plant has an operating dephenolizer on-site), stripped of free ammonia and treated with lime (or caustic soda) to raise the pH to 11-12 units. Dephenolizer, free ammonia still, and any associated equilization steps are considered to be by-product recovery process components, and are not included among wastewater treatment costs.	2 to 4	5,000	2,400
C	FIXED AMMONIA STRIPPING - Steam stripping stills are used to remove as much ammonia as possible prior to further treatment. Most operations use lime in Step B, but an increasing trend toward caustic soda usage has been observed, particularly since lime still sludges are considered to be hazardous wastes under RCRA requirements.	8 to 10	10,000	4,200
D	EQUALIZATION - Blend the discharge from Step C with wastewaters from crystallizer barometric condenser and provide for sedimentation in a settling basin or tank with one day's retention time. Unreacted lime particles and other suspended matter separates out, and is periodically removed by clamshell bucket or transferred to vacuum filters (see subsequent step).	4 to 6	50,000	20,000

TABLE VIII-4
CONTROL AND TREATMENT TECHNOLOGIES
COKEMAKING SUBCATEGORY
PAGE 2

C&TT Step	Description	Implementation Time (Months)	Land Usage (ft^2) I&S	Land Usage (ft^2) Merchant
	BIOLOGICAL TREATMENT SYSTEM:			
E	NEUTRALIZATION WITH ACID - The overflow from Step D is monitored and adjusted as necessary.	2 to 4	-	-
F	AERATION - The total wastewater flow from Step E is aerated by vigorous mechanical agitation or by the use of air blowers and subsurface diffusers. This step provides oxygen necessary to support bio-organisms in Step G.	4 to 6	3,200	1,200
G	BIOLOGICAL OXIDATION - Wastewaters are treated in a single-stage activated sludge basin provided with its own clarifier and sludge recycle system. At least 24 hour retention time is provided. If necessary, up to 50 gallons/ton of fresh water is added to the basin to optimize conditions for bio-oxidation.	12 to 18	80,000	32,000
H	VACUUM FILTRATION - Excess sludges from clarifier underflows and equalization basin are dewatered by vacuum filters. Filtrate is returned to the activated sludge basin. (Last step in BPT system.)	6 to 8	3,200	1,600
I	RECYCLE - Convert barometric condenser on crystallizer from once-through to 96 percent recycle system, with four percent blowdown to treatment. Replace up to 50 GPT of optimization water with blowdowns from air pollution emission scrubbers; dispose of excess scrubber blowdown from pushing by quenching operation.	6 to 8	-	-

TABLE VIII-4
CONTROL AND TREATMENT TECHNOLOGIES
COKEMAKING SUBCATEGORY
PAGE 3

C&TT Step	Description	Implementation Time (Months)	Land Usage (ft^2)	
			I&S	Merchan
J	AERATION - An additional aeration step is provided in a second-stage bio-oxidation system. As in Step F, the aeration system may be either mechanical agitation or air injection via blowers, and diffusers.	4 to 6	3,200	1,200
K	BIOLOGICAL OXIDATION - A second stage of activated sludge treatment is installed to provide further control of ammonia-N, cyanide, phenols (4AAP) and other toxic, organic pollutants. This stage also includes a clarifier and sludge recycle system.	12 to 18	80,000	32,00
L	NEUTRALIZATION WITH CAUSTIC SODA - As treatment proceeds in the second-stage activated sludge system, there is a tendency to produce acidic end-products which could inhibit bio-oxidation. To prevent this, caustic soda solutions are added to the system to control such acidity.	2 to 4	-	-
M	SODIUM CARBONATE ADDITION - Since bio-organisms in the first stage of activated sludge treatment will utilize most of the carbon available in wastewaters, a supplemental carbon source is added to the second stage basin. Sodium carbonate is added for this purpose and to aid in buffering the system.	2 to 4	625	625
N	COOLING TOWER - In order to adequately control temperatures without using excessive dilution water, side-stream cooling of a portion (up to 75 percent) of the total wastewater flow is achieved using a cooling tower. Uncontrolled temperature changes outside a narrow range adversely affect biota. (Last step in selected BAT system - BAT 1.)	9 to 12	4,800	2,400

TABLE VIII-4
CONTROL AND TREATMENT TECHNOLOGIES
COKEMAKING SUBCATEGORY
PAGE 4

C&TT Step	Description	Implementation Time (Months)	Land Usage (ft^2) I&S	Land Usage (ft^2) Merchant
O	PRESSURE FILTRATION - The effluent from Step N is passed through pressure filters to provide additional suspended matter removal. Filter backwash is returned to the activated sludge system clarifier. (Last step in BAT-2).	12 to 18	1,200	800
P	POWDERED ACTIVATED CARBON ADDITION - To further enhance control of ammonia and organics, powdered activated carbon is added to both activated sludge stages. The filtration provided in Step O prevents carryover of powdered carbon as a contributor to TSS loads. (Last step in BAT-3.)	10 to 12	400	200
Q	RECYCLE TREATED WATER TO QUENCHING OPERATIONS - All of the effluent from Step N (or any subsequent step) is collected and consumed in coke quenching operations as a replacement for water consumed there. This option can cause serious air pollution impacts due to the effluent's high dissolved solids content, which then flashes off as airborne particulate matter. (Last step in BAT-4.)	4 to 6	-	-
	PHYSICAL/CHEMICAL TREATMENT SYSTEM:			
A	GAS FLOTATION (Final Cooler Blowdown and Benzol Plant Wastewaters Only) - Waste pickle liquor is used to break emulsions, and an inert gas mixture is introduced to enhance the separation of oils and greases by flotation.	8 to 10	1,200	400
B	LIME ADDITION - Wastewaters from Step A are mixed with waste ammonia liquor and miscellaneous process wastes, dephenolized (if plant has an operating dephenolizer on-site), stripped of free	2 to 4	5,000	2,400

TABLE VIII-4
CONTROL AND TREATMENT TECHNOLOGIES
COKEMAKING SUBCATEGORY
PAGE 5

			Land Usage (ft^2)	
C&TT Step	Description	Implementation Time (Months)	I&S	Merchan
B	ammonia and treated with lime (or caustic soda) to raise the pH to 11-12 units. Dephenolizer, free ammonia still, and any associated equilization steps are considered to be by-product recovery process components, and are not included as wastewater treatment.			
C	FIXED AMMONIA STRIPPING - Steam stripping stills are used to remove as much ammonia as possible prior to further treatment. Most operations use lime in Step B, but an increasing trend toward caustic soda usage has been observed.	8 to 10	10,000	4,200
D	EQUALIZATION - Blend the discharge from Step C with wastewaters from crystallizer barometric condenser and provide for sedimentation in a settling basin or tank with one day's retention time. Unreacted lime particles and other suspended matter separates out, and are periodically removed by clamshell bucket or transferred to vacuum filters for dewatering (see subsequent step).	4 to 6	50,000	20,00
E	NEUTRALIZATION WITH ACID - The overflow from Step D is monitored and adjusted as necessary to assure that the treated effluent lies within the 6.0 to 9.0 pH range.	2 to 4	-	-
F	RECYCLE - Convert barometric condenser on crystallizer from once-through to 96 percent recycle system, with four percent blowdown to treatment. This reduces flows to treatment, and increases treatment plant efficiency.	6 to 8	-	-
G	PRESSURE FILTRATION - The total plant effluent is passed through pressure filters in order to remove additional suspended matter and protect the carbon adsorption system which follows.	12 to 18	1,200	800

TABLE VIII-4
CONTROL AND TREATMENT TECHNOLOGIES
COKEMAKING SUBCATEGORY
PAGE 6

C&TT Step	Description	Implementation Time (Months)	Land Usage (ft^2) I&S	Land Usage (ft^2) Merchant
H	GRANULAR ACTIVATED CARBON ADSORPTION - Following Step G, a full scale system using towers packed with activated carbon granules is installed to provide effective control of toxic organic pollutants and other adsorbable pollutants. Spent carbon may be regenerated by means of on-site furnaces, or may be returned to its supplier for reactivation off-site.	18 to 24	3,200	1,200
I	EQUALIZATION - Treated effluents from Step H are collected and retained for four to six hours in a settling basin prior to discharge. This step provides time for settling of any carbon granules or other suspended matter which may have left the carbon towers. (Last step in selected BAT P/C system.)	4 to 6	8,000	3,200
J	BREAKPOINT CHLORINATION - Further treatment for control of non-adsorbed organics, cyanide and ammonia is provided via two-step (alkaline and breakpoint) chlorine addition to complete oxidize such pollutants. Careful monitoring and control must be provided to minimize formation of chlorinated intermediates, and Step J must be followed by a dechlorination step.	12 to 18	3,200	1,200
K	DECHLORINATION VIA SO_2 ADDITION - Any residual chlorine from Step J is eliminated by adding a suitable reducing agent such as SO_2 or sodium metabisulfite prior to discharge. (Last step in BAT-2 P/C system.)	2 to 4	625	400
L	RECYCLE TREATED WATER TO QUENCHING OPERATIONS - All of the effluent from Step I (or K) is collected and consumed in coke quenching operations as a replacement for fresh water consumed there. This option can cause serious air pollution impacts due to the effluent's high dissolved solids content, which then flashes off as airborne particulate matter. (Last step in BAT-3 P/C system.)	4 to 6	-	-

TABLE VIII-4
CONTROL AND TREATMENT TECHNOLOGIES
COKEMAKING SUBCATEGORY
PAGE 7

C&TT Step	Description	Implementation Time (Months)	Land Usage (ft^2) I&S	Land Usage (ft^2) Merchant
II.	**BEEHIVE COKEMAKING:**			
A	SETTLING BASIN - A sedimentation pond is provided to collect all wastewaters, which are retained until coke fines and other particulates settle out. Pond must be periodically cleaned out to insure sufficient retention times.	2 to 4	-	3,200
B	RECYCLE - All of the effluent from Step A is pumped back for use in the coke quenching process. The additional impact on air quality is minimal when contrasted with the beehive cokemaking process itself. There is no aqueous discharge from the wastewater treatment system (Last step in Selected BPT system.)	2 to 4	-	-

TABLE VIII-5a

BPT TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory:	Cokemaking
:	Iron & Steel Plants
:	Biological

Model Size - TPD:	4,700
Oper. Days/Year :	365
Turns/Day :	3

C&TT Step	A	B	C	D	E	F	G	H	Total
Investment ($ x 10^{-3})	90.0	264.3	3,361.4	320.5	80.3	105.1	762.0	248.5	5,232.1
Annual Costs ($ x 10^{-3})									
Capital	8.1	23.8	302.2	28.8	7.2	9.5	68.5	22.3	470.4
Operation & Maintenance	3.1	9.2	117.6	11.2	2.8	3.7	26.7	8.7	183.0
Land	0.1	0.3	0.6	2.8		0.2	4.5	0.2	8.7
Sludge Disposal								2.6	2.6
Hazardous Waste Disposal				22.3					22.3
Oil Disposal									
Energy & Power	2.6	3.3	6.4	1.6	1.6	16.3	4.2	5.7	41.7
Steam			380.4				142.7		523.1
Waste Acid									
Crystal Disposal									
Chemical		119.7			7.5				127.2
TOTAL	13.9	156.3	807.2	66.7	19.1	29.7	246.6	39.5	1,379.0
Credits									
Scale									
Sinter									
Oil									
Acid Recovery									
TOTAL CREDITS									
NET TOTAL	13.9	156.3	807.2	66.7	19.1	29.7	246.6	39.5	1,379.0

KEY TO C&TT STEPS

A: Gas Flotation
B: Lime Addition
C: Fixed Ammonia Stripping
D: Equalization
E: Neutralization with Acid
F: Aeration
G: Biological Oxidation
H: Vacuum Filtration

TABLE VIII-5b

BPT TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory:	Cokemaking	Model Size - TPD:	1,690
Subdivision:	Merchant Plants	Oper. Days/Year :	365
:	Biological	Turns/Day :	3

C&TT Step	A	B	C	D	E	F	G	H	Total
Investment ($ x 10^{-3})	86.7	157.3	1,989.3	182.3	39.8	59.2	428.9	153.5	3,097.0
Annual Costs ($ x 10^{-3})									
Capital	7.8	14.1	178.8	16.4	3.6	5.3	38.6	13.8	278.4
Operation & Maintenance	3.0	5.5	69.6	6.4	1.4	2.1	15.0	5.4	108.4
Land	0.1	0.1	0.2	1.1		0.1	1.8	0.1	3.5
Sludge Disposal								0.9	0.9
Hazardous Waste Disposal				9.9					9.9
Oil Disposal									
Energy & Power	1.3	1.5	2.9	0.7	0.7	6.5	1.6	4.9	20.1
Steam			159.4				54.7		214.1
Waste Acid									
Crystal Disposal									
Chemical		50.4			2.8				53.2
TOTAL	12.2	71.6	410.9	34.5	8.5	14.0	111.7	25.1	688.5
Credits									
Scale									
Sinter									
Oil									
Acid Recovery									
TOTAL CREDITS									
NET TOTAL	12.2	71.6	410.9	34.5	8.5	14.0	111.7	25.1	688.5

KEY TO C&TT STEPS

A: Gas Flotation
B: Lime Addition
C: Fixed Ammonia Stripping
D: Equalization
E: Neutralization with Acid
F: Aeration
G: Biological Oxidation
H: Vacuum Filtration

TABLE VIII-5c

BPT TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory:	Cokemaking	Model Size - TPD:	4,700
Subdivision:	Iron & Steel Plants	Oper. Days/Year :	365
:	Physical/Chemical	Turns/Day :	3

C&TT Step	A	B	C	D	E	Total
Investment ($ x 10^{-3})	90.0	264.3	3,361.4	320.5	80.3	4,116.5
Annual Costs ($ x 10^{-3})						
Capital	8.1	23.8	302.2	28.8	7.2	370.1
Operation & Maintenance	3.1	9.2	117.6	11.2	2.8	143.9
Land	0.1	0.3	0.6	2.8		3.8
Sludge Disposal						
Hazardous Waste Disposal				22.3		22.3
Oil Disposal						
Energy & Power	2.6	3.3	6.4	1.6	1.6	15.5
Steam			380.4			380.4
Waste Acid						
Crystal Disposal						
Chemical		119.7			7.5	127.2
TOTAL	13.9	156.3	807.2	66.7	19.1	1,063.2
Credits						
Scale						
Sinter						
Oil						
Acid Recovery						
TOTAL CREDITS						
NET TOTAL	13.9	156.3	807.2	66.7	19.1	1,063.2

KEY TO C&TT STEPS

A: Gas Flotation
B: Lime Addition
C: Fixed Ammonia Stripping
D: Equalization
E: Neutralization with Acid

TABLE VIII-5d

BPT TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Cokemaking
: Merchant Plants
: Physical/Chemical

Model Size - TPD: 1,690
Oper. Days/Year : 365
Turns/Day : 3

C&TT Step	A	B	C	D	E	Total
Investment ($ x 10^{-3})	86.7	157.3	1,989.3	182.3	39.8	2,455.4
Annual Costs ($ x 10^{-3})						
Capital	7.8	14.1	178.8	16.4	3.6	220.7
Operation & Maintenance	3.0	5.5	69.6	6.4	1.4	85.9
Land	0.1	0.1	0.2	1.1		1.5
Sludge Disposal						
Hazardous Waste Disposal				9.9		9.9
Oil Disposal						
Energy & Power	1.3	1.5	2.9	0.7	0.7	7.1
Steam						
Waste Acid			159.4			159.4
Crystal Disposal						
Chemical		50.4			2.8	53.2
TOTAL	12.2	71.6	410.9	34.5	8.5	537.7
Credits						
Scale						
Sinter						
Oil						
Acid Recovery						
TOTAL CREDITS						
NET TOTAL	12.2	71.6	410.9	34.5	8.5	537.7

KEY TO C&TT STEPS

A: Gas Flotation
B: Lime Addition
C: Fixed Ammonia Stripping
D: Equalization
E: Neutralization with Acid

TABLE VIII-6

BAT TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Cokemaking
: Iron & Steel Plants
: Biological

Model Size - TPD: 4,700
Oper. Days/Year : 365
Turns/Day : 3

C&TT Step	Total BPT	BAT Alternative 1							BAT Alternative 2 Alt. 1 Plus:		BAT Alternative 3 Alt. 1 Plus:			BAT Alternative 4 Alt. 1 Plus:	
		I	J	K	L	M	N	Total	O	Total	O	P	Total	Q	Total
Investment ($x10^{-3})	5,232.1	91.5	83.4	604.8	107.3	169.7	356.7	1,413.4	513.4	1,926.8	513.4	61.0	1,987.8	258.2	1,671.6
Annual Costs ($x10^{-3})															
Capital	470.4	8.2	7.5	54.4	9.6	15.3	32.1	127.1	46.2	173.3	46.2	5.5	178.8	23.2	150.3
Operation & Maintenance	183.0	3.2	2.9	21.2	3.8	5.9	12.5	49.5	18.0	67.5	18.0	2.1	69.6	9.0	58.5
Land	8.7		0.1	4.5		0.1	0.3	5.0	0.1	5.1	0.1	0.1	5.2		5.0
Sludge Disposal	2.6														
Hazardous Waste Disposal	22.3														
Oil Disposal															
Energy & Power	41.7		12.2	3.3	1.3	2.3	16.3	35.4	6.5	41.9	6.5	4.1	46.0		35.4
Steam	523.1			97.3				97.3		97.3			97.3		97.3
Waste Acid															
Crystal Disposal															
Chemical	1,379.0	11.4	22.7	180.7	18.6	32.4	61.2	327.0	70.8	397.8	70.8	225.3	623.1	32.2	359.2
TOTAL															
Credits															
Scale															
Sinter															
Oil															
Acid Recovery															
TOTAL CREDITS															
NET TOTAL	1,379.0	11.4	22.7	180.7	18.6	32.4	61.2	327.0	70.8	397.8	70.8	225.3	623.1	32.2	359.2

KEY TO TREATMENT ALTERNATIVES

PSES-2, PSNS-2 = BPT
PSES-3, PSNS-3 = BPT + BAT-1
PSES-4, PSNS-4 = BPT + BAT-2
PSES-5, PSNS-5 = BPT + BAT-3
PSES-6, PSNS-6 = BPT + BAT-4

KEY TO C&TT STEPS

I: Barometric Condenser Recycle
J: Aeration
K: Biological Oxidation
L: Caustic Addition
M: Carbonate Addition
N: Cooling Tower
O: Pressure Filtration
P: Powdered Activated Carbon Addition
Q: Coke Quenching

TABLE VIII-7

BAT TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory:	Cokemaking	Model Size - TPD:	1,690
Subdivision:	Merchant Plants	Oper. Days/Year :	365
:	Biological	Turns/Day :	3

		BAT Alternative 1							BAT Alternative 2 Alt. 1 Plus:		BAT Alternative 3 Alt. 1 Plus:			BAT Alternative 4 Alt. 1 Plus:	
C&TT Step	Total BPT	I	J	K	L	M	N	Total	O	Total	O	P	Total	Q	Total
Investment ($ x 10^{-3})	3,097.0	28.9	48.2	349.0	61.9	97.9	134.7	720.6	203.2	923.8	203.2	35.2	959.0	149.0	869.6
Annual Costs ($ x 10^{-3})															
Capital	278.4	2.6	4.3	31.4	5.6	8.8	12.1	64.8	18.3	83.1	18.3	3.2	86.3	13.4	78.2
Operation & Maintenance	108.4	1.0	1.7	12.2	2.2	3.4	4.7	25.2	7.1	32.3	7.1	1.2	33.5	5.2	30.4
Land	3.5		0.1	1.8		0.1	0.1	2.1	0.1	2.2	0.1	0.1	2.3		2.1
Sludge Disposal	0.9														
Hazardous Waste Disposal	9.9														
Oil Disposal															
Energy & Power	20.1		4.9	1.6	0.7	1.0	6.5	14.7	1.6	16.3	1.6	2.4	18.7		14.7
Steam	214.1			39.9				39.9		39.9			39.9		39.9
Waste Acid															
Crystal Disposal															
Chemical	53.2				1.6	3.5		5.1		5.1		85.4	90.5		5.1
TOTAL	688.5	3.6	11.0	86.9	10.1	16.8	23.4	151.8	27.1	178.9	27.1	92.3	271.2	18.6	170.4
Credits															
Scale															
Sinter															
Oil															
Acid Recovery															
TOTAL CREDITS															
NET TOTAL	688.5	3.6	11.0	86.9	10.1	16.8	23.4	151.8	27.1	178.9	27.1	92.3	271.2	18.6	170.4

KEY TO C&TT STEPS

I: Barometric Condenser Recycle
J: Aeration
K: Biological Oxidation
L: Caustic Addition
M: Carbonate Addition
N: Cooling Tower
O: Pressure Filtration
P: Powdered Activated Carbon Addition
Q: Coke Quenching

TABLE VIII-8a

BAT TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Cokemaking
: Iron & Steel Plants
: Physical/Chemical

Model Size - TPD: 4,700
Oper. Days/Year : 365
Turns/Day : 3

C&TT Step	Total BPT	BAT Alternative 1 F	G	H	I	Total	BAT Alternative 2 Alt. 1 Plus: J	K	Total	BAT Alternative 3 Alt 1 Plus: L	Total
Investment ($ x 10^{-3})	4,116.5	91.5	404.9	2,985.8	233.3	3,715.5	377.3	180.8	4,273.6	203.6	3,919.1
Annual Costs ($ x 10^{-3})											
Capital	370.1	8.2	36.4	268.4	21.0	334.0	33.9	16.3	384.2	18.3	352.3
Operation & Maintenance	143.9	3.2	14.2	104.5	8.2	130.1	13.2	6.3	149.6	7.1	137.2
Land	3.8		0.1	0.6	1.7	2.4	0.3	0.3	3.0		2.4
Sludge Disposal											
Hazardous Waste Disposal	22.3				16.7	16.7			16.7		16.7
Oil Disposal											
Energy & Power	15.5		5.1	16.3	1.0	22.4	3.6	3.3	29.3		22.4
Steam	380.4			17.9		17.9			17.9		17.9
Waste Acid											
Crystal Disposal											
Chemical	1,063.2	11.4	55.8	1,441.4	48.6	1,557.2	230.0	43.8	1,831.0	25.4	1,582.6
TOTAL											
Credits											
Scale											
Sinter											
Oil											
Acid Recovery											
TOTAL CREDITS											
NET TOTAL	1,063.2	11.4	55.8	1,441.4	48.6	1,557.2	230.0	43.8	1,831.0	25.4	1,582.6

KEY TO C&TT STEPS

F: Recycle
G: Pressure Filtration
H: Granular Activated Carbon Adsorption
I: Equalization
J: Breakpoint Chlorination
K: Sulfur Dioxide Addition
L: Coke Quenching

TABLE VIII-8b

BAT TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Cokemaking
Subdivision: Merchant Plants
: Physical/Chemical

Model Size - TPD: 1,690
Oper. Days/Year : 365
Turns/Day : 3

C&TT Step	Total BPT	BAT Alternative 1					BAT Alternative 2 Alt. 1 Plus:			BAT Alternative 3 Alt 1 Plus:	
		F	G	H	I	Total	J	K	Total	L	Total
Investment ($ x 10^{-3})	2,455.4	28.9	165.0	1,771.5	138.4	2,103.8	223.9	107.3	2,435.0	120.9	2,224.7
Annual Costs ($ x 10^{-3})											
Capital	220.7	2.6	14.8	159.3	12.4	189.1	20.1	9.6	218.8	10.9	200.0
Operation & Maintenance	85.9	1.0	5.8	62.0	4.8	73.6	7.8	3.8	85.2	4.2	77.8
Land	1.5		0.1	0.4	0.8	1.3	0.2	0.2	1.7		1.3
Sludge Disposal											
Hazardous Waste Disposal	9.9				7.5	7.5			7.5		7.5
Oil Disposal											
Energy & Power	7.1		1.5	6.9	0.7	9.1	1.8	1.5	12.4		9.1
Steam	159.4			7.6		7.6			7.6		7.6
Waste Acid											
Crystal Disposal											
Chemical	53.2			619.0		619.0	106.6	10.9	736.5		619.0
TOTAL	537.7	3.6	22.2	855.2	26.2	907.2	136.5	26.0	1,069.7	15.1	922.3
Credits											
Scale											
Sinter											
Oil											
Acid Recovery											
TOTAL CREDITS											
NET TOTAL	537.7	3.6	22.2	855.2	26.2	907.2	136.5	26.0	1,069.7	15.1	922.3

KEY TO C&TT STEPS

F: Recycle
G: Pressure Filtration
H: Granular Activated Carbon Adsorption
I: Equalization
J: Breakpoint Chlorination
K: Sulfur Dioxide Addition
L: Coke Quenching

TABLE VIII-9a

NSPS TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Cokemaking
Subdivision: Iron and Steel Plants

Model Size - TPD: 4,700
Oper. Days/Year : 365
Turns/Day : 3

	Alternative 1														
C&TT Step	A	B	C	D	E	F	G	H	I	G	H	C	J	K	Total
Investment ($ x 10^3)	91.5	90.0	88.4	3,714.2	296.0	74.2	83.4	604.8	175.5	83.4	604.8	107.3	169.7	356.7	6,539.9
Annual Costs ($ x 10^{-3})															
Capital	8.2	8.1	7.9	333.9	26.6	6.7	7.5	54.4	15.8	7.5	54.4	9.6	15.3	32.1	588.0
Operation & Maintenance	3.2	3.1	3.1	130.0	10.4	2.6	2.9	21.2	6.1	2.9	21.2	3.8	5.9	12.5	228.9
Land		0.1	0.3	0.6	2.4		0.1	4.5	0.1	0.1	4.5		0.1	0.3	13.1
Sludge Disposal									1.8						1.8
Hazardous Waste Disposal					3.9										3.9
Oil Disposal															
Energy & Power		2.6	3.9	6.9	1.3	1.6	12.2	3.3	3.6	12.2	3.3	1.3	2.3	16.3	70.8
Steam				421.4				97.3			97.3				616.0
Waste Acid															
Crystal Disposal															
Chemical			456.6			6.6						3.9	8.8		475.9
TOTAL	11.4	13.9	471.8	892.8	44.6	17.5	22.7	180.7	27.4	22.7	180.7	18.6	32.4	61.2	1,998.4
Credits															
Scale															
Sinter															
Oil															
Acid Recovery															
TOTAL CREDITS															
NET TOTAL	11.4	13.9	471.8	892.8	44.6	17.5	22.7	180.7	27.4	22.7	180.7	18.6	32.4	61.2	1,998.4

KEY TO C&TT STEPS

A:	Barometric Condenser Recycle	E:	Settling	I:	Vacuum Filtration
B:	Gas Flotation	F:	Neutralization with Acid	J:	Carbonate Addition
C:	Caustic Addition	G:	Aeration	K:	Cooling Tower
D:	Fixed Ammonia Stripping	H:	Biological Oxidation		

TABLE VIII-9a
NSPS TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS
PAGE 2

C&TT Step	Alternative 2 Alt. 1 Plus: L	 Total	Alternative 3 Alt. 1 Plus: L	 M	 Total
Investment ($ x 10^{-3})	513.4	7,053.3	513.4	61.0	7,114.3
Annual Cost ($ x 10^{-3})					
Capital	46.2	634.2	46.2	5.5	639.7
Operation & Maintenance	18.0	246.9	18.0	2.1	249.0
Land	0.1	13.2	0.1	0.1	13.3
Sludge Disposal		1.8			1.8
Hazardous Waste Disposal		3.9			3.9
Oil Disposal					
Energy & Power	6.5	77.3	6.5	4.1	81.4
Steam		616.0			616.0
Waste Acid					
Crystal Disposal					
Chemical		475.9		213.5	689.5
TOTAL	70.8	2,069.2	70.8	225.3	2,294.5
Credits					
Scale					
Sinter					
Oil					
Acid Recovery					
TOTAL CREDITS					
NET TOTAL	70.8	2,069.2	70.8	225.3	2,294.5

KEY TO C&TT STEPS

L: Pressure Filtration
M: Powdered Activated Carbon Addition

TABLE VIII-9b

NSPS TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Cokemaking
Subdivision: Merchant Plants

Model Size - TPD: 1,690
Oper. Days/Year : 365
Turns/Day : 3

	Alternative 1														
C&TT Step	A	B	C	D	E	F	G	H	I	G	H	C	J	K	Total
Investment ($ x 10^{-3})	28.9	90.0	51.9	2,168.3	170.8	37.3	48.2	349.0	126.0	48.2	349.0	61.9	97.9	134.7	3,762.1
Annual Costs ($ x 10^{-3})															
Capital	2.6	8.1	4.7	194.9	15.4	3.4	4.3	31.4	11.3	4.3	31.4	5.6	8.8	12.1	338.3
Operation & Maintenance	1.0	3.1	1.8	75.9	6.0	1.3	1.7	12.2	4.4	1.7	12.2	2.2	3.4	4.7	131.6
Land		0.1	0.2	0.3	1.4		0.1	1.8	0.1	0.1	1.8		0.1	0.1	6.1
Sludge Disposal									0.7						0.7
Hazardous Waste Disposal					2.0										2.0
Oil Disposal															
Energy & Power		1.3	1.6	3.3	0.7	0.7	4.9	1.3	1.5	4.9	1.3	0.5	1.0	6.5	29.5
Steam				182.2				38.9			38.9				260.0
Waste Acid															
Crystal Disposal															
Chemical			207.0			2.6							1.6	3.5	214.7
TOTAL	3.6	12.6	215.3	456.6	25.5	8.0	11.0	85.6	18.0	11.0	85.6	9.9	16.8	23.4	982.9
Credits															
Scale															
Sinter															
Oil															
Acid Recovery															
TOTAL CREDITS															
NET TOTAL	3.6	12.6	215.3	456.6	25.5	8.0	11.0	85.6	18.0	11.0	85.6	9.9	16.8	23.4	982.9

KEY TO C&TT STEPS

A: Barometric Condenser Recycle
B: Gas Flotation
C: Caustic Addition
D: Fixed Ammonia Stripping
E: Settling
F: Neutralization with Acid
G: Aeration
H: Biological Oxidation
I: Vacuum Filtration
J: Carbonate Addition
K: Cooling Tower

TABLE VIII-9b
NSPS TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS
PAGE 2

C&TT Step	Alternative 2 Alt. 1 Plus: L	Alternative 2 Alt. 1 Plus: Total	Alternative 3 Alt. 1 Plus: L	Alternative 3 Alt. 1 Plus: M	Alternative 3 Alt. 1 Plus: Total
Investment ($ x 10^{-3})	203.2	3,965.3	203.2	35.2	4,000.5
Annual Costs ($ x 10^{-3})					
Capital	18.3	356.6	18.3	3.2	359.8
Operation & Maintenance	7.1	138.7	7.1	1.2	139.9
Land	0.1	6.2	0.1	0.1	6.3
Sludge Disposal		0.7			0.7
Hazardous Waste Disposal		2.0			2.0
Oil Disposal					
Energy & Power	1.6	31.1	1.6	2.4	33.5
Steam		260.0			260.0
Waste Acid					
Crystal Disposal					
Chemical		214.7		85.4	300.1
TOTAL	27.1	1,010.0	27.1	92.3	1,102.3
Credits					
Scale					
Sinter					
Oil					
Acid Recovery					
TOTAL CREDITS					
NET TOTAL	27.1	1,010.0	27.1	92.3	1,102.3

KEY TO C&TT STEPS

L: Pressure Filtration
M: Powdered Activated Carbon Addition

TABLE VIII-10a

PSES/PSNS TREATMENT MODEL COSTS*: BASIS 7/1/78 DOLLARS

Subcategory: Cokemaking
Subdivision: Iron and Steel Plants

Model Size - TPD: 4,700
Oper. Days/Year : 365
Turns/Day : 3

	PSES/PSNS Alternative 1						
C&TT Step	A	B	C	D	E	F	Total
Investment ($ x 10^{-3})	91.5	90.0	264.3	3,361.4	155.0	59.0	4,021.2
Annual Costs ($ x 10^{-3})							
Capital	8.2	8.1	23.8	302.2	13.9	5.3	361.5
Operation & Maintenance	3.2	3.1	9.2	117.6	5.4	2.1	140.6
Land		0.1	0.3	0.6	1.7	0.1	2.8
Sludge Disposal							
Hazardous Waste Disposal					23.7		23.7
Oil Disposal							
Energy & Power		2.6	3.3	6.4	1.6	1.6	15.5
Steam				380.4			380.4
Waste Acid							
Crystal Disposal							
Chemical				119.7		4.4	
TOTAL	11.4	13.9	156.3	807.2	46.3	13.5	1,048.6
Credits							
Scale							
Sinter							
Oil							
Acid Recovery							
TOTAL CREDITS							
NET TOTAL	11.4	13.9	156.3	807.2	46.3	13.5	1,048.6

KEY TO C&TT STEPS.

A: Recycle
B: Gas Flotation
C: Neutralization with Lime
D: Fixed Ammonia Stripping
E: Settling
F: Neutralization with Acid

---

* Costs for PSES Alternatives 2 through 6 appear on Table VIII-6.

TABLE VIII-10b

PSES/PSNS TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Cokemaking
Subdivision: Merchant Plants

Model Size - TPD: 920
Oper. Days/Year : 365
Turns/Day : 3

	Alternative 1							Alternative 2 Components B, C, & D Plus:					
C&TT Step	A	B	C	D	E	F	Total	E	F	G	H	I	Total
Investment ($ x 10^{-3})	25.5	71.9	109.5	1,380.8	48.8	21.0	1,657.5	126.4	27.6	41.0	297.2	126.0	2,180.4
Annual Costs ($ x 10^{-3})													
Capital	2.3	6.5	9.8	124.1	4.4	1.9	149.0	11.4	2.5	3.7	26.7	11.3	196.0
Operation & Maintenance	0.9	2.5	3.8	48.3	1.7	0.7	57.9	4.4	1.0	1.4	10.4	4.4	76.2
Land		0.1	0.1	0.1	0.5	0.1	0.9	0.7		0.1	1.0	0.1	2.2
Sludge Disposal												0.5	0.5
Hazardous Waste Disposal					5.3		5.3	4.6					4.6
Oil Disposal													
Energy & Power		1.0	1.0	2.0	0.7	0.7	5.4	0.7	0.7	3.3	1.1	4.9	14.7
Steam				88.8			88.8				29.6		118.4
Waste Acid													
Crystal Disposal													
Chemical			27.6			1.0	28.6		1.5				29.1
TOTAL	3.2	10.1	42.3	263.3	12.6	4.4	335.9	21.8	5.7	8.5	68.8	21.2	441.7
Credits													
Scale													
Sinter													
Oil													
Acid Recovery													
TOTAL CREDITS													
NET TOTAL	3.2	10.1	42.3	263.3	12.6	4.4	335.9	21.8	5.7	8.5	68.8	21.2	441.7

TABLE VIII-10b
PSES/PSNS TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS
PAGE 2

	Alternative 3 Component A Plus:						Alternative 4 Alt. 3 Plus:		Alternative 5 Alt. 3 Plus:			Alternative 6 Alt. 3 Plus:	
C&TT Step	G	H	J	K	L	Total	M	Total	M	N	Total	O	Total
Investment ($ x 10^{-3})	33.5	242.5	43.0	68.0	93.7	506.2	141.2	647.4	141.2	24.5	672.2	103.5	609.7
Annual Costs ($ x 10^{-3})													
Capital	3.0	21.8	3.9	6.1	8.4	45.5	12.7	58.2	12.7	2.2	60.4	9.3	54.8
Operation & Maintenance	1.2	8.5	1.5	2.4	3.3	17.8	4.9	22.7	4.9	0.9	23.6	3.6	21.4
Land	0.1	0.9		0.1	0.1	1.2	0.1	1.3	0.1	0.1	1.4		1.2
Sludge Disposal													
Hazardous Waste Disposal													
Oil Disposal													
Energy & Power	2.8	1.0	0.5	0.7	3.9	8.9	1.3	10.2	1.3	1.1	11.3		8.9
Stema		22.8				22.8		22.8			22.8		22.8
Waste Acid													
Crystal Disposal													
Chemical			0.9	1.9		2.8		2.8		46.5	49.3		2.8
TOTAL	7.1	55.0	6.8	11.2	15.7	99.0	19.0	118.0	19.0	50.8	168.8	12.9	111.9
Credits													
Scale													
Sinter													
Oil													
Acid Recovery													
TOTAL CREDITS													
NET TOTAL	7.1	55.0	6.8	11.2	15.7	99.0	19.0	118.0	19.0	50.8	168.8	12.9	111.9

KEY TO C&TT STEPS

A: Barometric Condenser Recycle
B: Gas Flotation
C: Neutralization with Lime
D: Fixed Ammonia Stripping
E: Settling
F: Neutralization with Acid
G: Aeration
H: Biological Addition
I: Vacuum Filtration
J: Caustic Addition
K: Carbonate Addition
L: Cooling Tower
M: Pressure Filtration
N: Powdered Activated Carbon Addition
O: Coke Quenching

TABLE VIII-11

INDUSTRY - WIDE COST SUMMARY*
COKEMAKING SUBCATEGORY
(ALL COSTS IN MILLIONS 7/1/78 DOLLARS)

Subcategory/Subdivision	No. of Plants	BPT				BAT				PSES			
		Capital		Annual		Capital		Annual		Capital		Annual	
		In-Place	Requried	In-Place	Required	In-Place	Required	In-Place	Required	In-Place	Required	In-Place	Required
A. By-Product Cokemaking:													
1. Iron & Steel Plants:													
a. Biological	28	96.98	41.50	25.45	9.51	4.83	28.62	0.92	6.96	-	-	-	-
b. Physical/Chemical	2	1.84	3.70	0.55	0.88	3.74	0.00	1.62	0.00	-	-	-	-
c. Pretreatment	8	-	-	-	-	-	-	-	-	28.21	7.52	7.04	1.12
Subtotal - Iron & Steel	38(1)	98.82	45.20	26.00	10.39	8.57	28.62	2.54	6.96	28.21	7.52	7.04	1.12
2. Merchant Plants:													
a. Biological	9	19.43	2.45	4.08	0.54	0.39	4.33	0.07	0.94	-	-	-	-
b. Physical/Chemical	1	2.69	0.00	0.59	0.00	2.16	0.00	0.98	0.00	-	-	-	-
c. Pretreatment	7	-	-	-	-	-	-	-	-	2.66	7.41	0.56	1.45
Subtotal - Merchant	17(2)	22.12	2.45	4.67	0.54	2.55	4.33	1.05	0.94	2.66	7.41	0.56	1.45
B. Beehive Cokemaking:													
Merchant	2	0.78	0.00	0.13	0.00	0.00	0.00	0.00	0.00	-	-	-	-
Subtotal - All By-Product	55	120.94	47.65	30.67	10.93	11.12	32.95	3.59	7.90	30.87	14.93	7.60	2.57
Subtotal - All Beehive	2	0.78	0.00	0.13	0.00	0.00	0.00	0.00	0.00	-	-	-	-
Total Cokemaking	57	121.72	47.65	30.80	10.93	11.12	32.95	3.59	7.90	30.87	14.93	7.60	2.57

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(1) Omits one plant confidential treatment of production-related data.
(2) Omits two plants confidential treatment of production-related data.

* These costs are for the selected treatment alternatives which are discussed in Sections IX, X and XIII.

TABLE VIII-12

ENERGY REQUIREMENT SUMMARY
BY-PRODUCT COKEMAKING SUBCATEGORY
BAT TREATMENT ALTERNATIVES

	Model Basis			Subcategory Total[1]	
	Alternative	Kw/hr	Annual Cost	Kw/hr	Annual Cost
Iron & Steel Plants - Biological	BAT-1	161.8	35,400	4,692	1,026,600
Iron & Steel Plants Physical/Chemical	BAT-1	102.3	22,400	205	44,800
Merchant Plants - Biological	BAT-1	67.1	14,700	671	147,000
Merchant Plants Physical/Chemical	BAT-1	41.6	9,100	42	9,100
Subtotal BAT-1				5,610	1,227,500
Iron & Steel Plants - Biological	BAT-2	191.5	41,900	5,554	1,215,100
Iron & Steel Plants Physical/Chemical	BAT-2	133.8	29,300	268	58,600
Merchant Plants - Biological	BAT-2	74.6	16,300	746	163,000
Merchant Plants Physical/Chemical	BAT-2	56.6	12,400	57	12,400
Subtotal BAT-2				6,625	1,449,103
Iron & Steel Plants - Biological	BAT-3	210.2	46,000	6,096	1,334,000
Merchant Plants - Biological	BAT-3	85.6	18,700	856	187,000
Subtotal BAT-3 (Bio only)				6,952	1,521,000
Iron & Steel Plants - Biological	BAT-4	161.8	35,400	4,692	1,026,600
Iron & Steel Plants Physical/Chemical	BAT-3	102.3	22,400	205	44,800
Merchant Plants - Biological	BAT-4	67.1	14,700	671	147,000
Merchant Plants Physical/Chemical	BAT-3	41.6	9,100	42	9,100
Subtotal Zero Discharge BAT				5,610	1,227,500

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[1] Data obtained by multiplying model basis by number of plants in each subdivision.

Note: All values represent increases over BPT energy requirements.

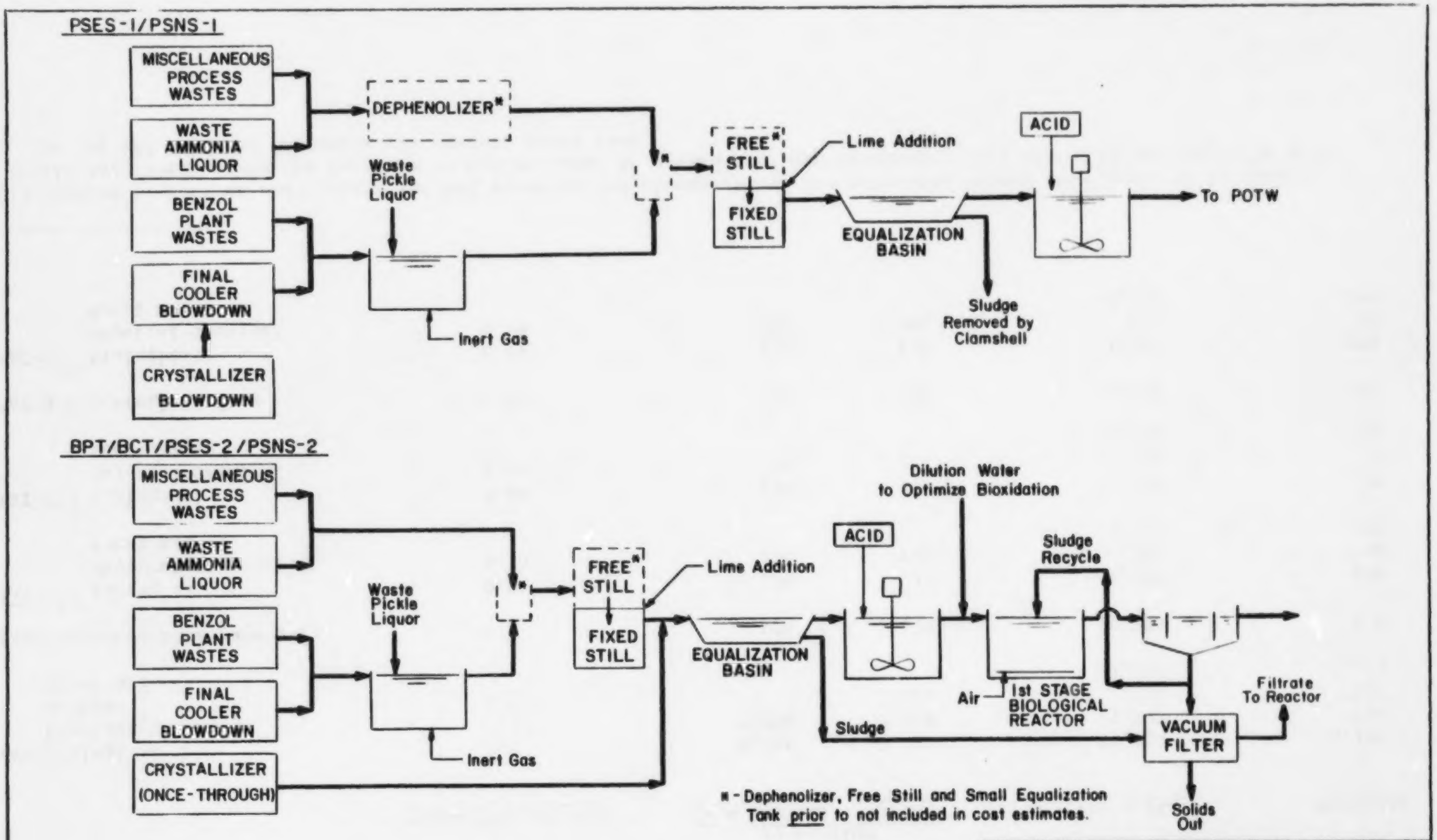
TABLE VIII-13

SOLID WASTES GENERATION SUMMARY
COKEMAKING SUBCATEGORY

	Model Basis			Subcategory Totals (Tons/Year)	
		Pounds/Day			
	Pounds/Ton of Coke	Iron & Steel	Merchant	Iron & Steel	Merchant
BPT-Biological	2.2	10,340	3,720	54,724	6,789
-Physical-Chemical	1.5	7,050	2,540	2,573	464
-Beehive(1)	1.0	-	1,000	-	365
Total BPT				57,297	7,618
PSES-Selected Alternate Only	1.5	7,050	1,380	10,293	2,015
BAT-1(2) Biological	0.04	190	70	1,006	128
Physical-Chemical	0.14	660	240	241	44
Total BAT-1				1,247	172
BAT-2(2) Biological	0.06	280	100	1,482	183
Physical Chemical	0.16	750	270	274	49
Total BAT-2				1,756	232
BAT-3(2) Biological Only	0.06	280	100	1,482	183
BAT-4(2) Biological	0.09	420	150	2,223	274
Physical-Chemical	0.18	850	300	310	55
Total BAT-4				2,533	329

---

(1) Beehive operations only appear for BPT since no additional solids are generated beyond this level of treatment.
(2) All BAT levels state the increase in solids loads as a result of BAT treatment. The stated value should be added to the BPT loads to determine the overall total load.


PSES-1/PSNS-1
MISCELLANEOUS PROCESS WASTES
WASTE AMMONIA LIQUOR
BENZOL PLANT WASTES
FINAL COOLER BLOWDOWN
CRYSTALLIZER BLOWDOWN
DEPHENOLIZER*
Waste Pickle Liquor
Inert Gas
*
FREE* STILL
FIXED STILL
Lime Addition
EQUALIZATION BASIN
Sludge Removed by Clamshell
ACID
To POTW
BPT/BCT/PSES-2/PSNS-2
MISCELLANEOUS PROCESS WASTES
WASTE AMMONIA LIQUOR
BENZOL PLANT WASTES
FINAL COOLER BLOWDOWN
CRYSTALLIZER (ONCE-THROUGH)
Waste Pickle Liquor
Inert Gas
*
FREE* STILL
FIXED STILL
Lime Addition
EQUALIZATION BASIN
ACID
Dilution Water to Optimize Bioxidation
Sludge Recycle
Air
1st STAGE BIOLOGICAL REACTOR
Sludge
Filtrate To Reactor
VACUUM FILTER
Solids Out

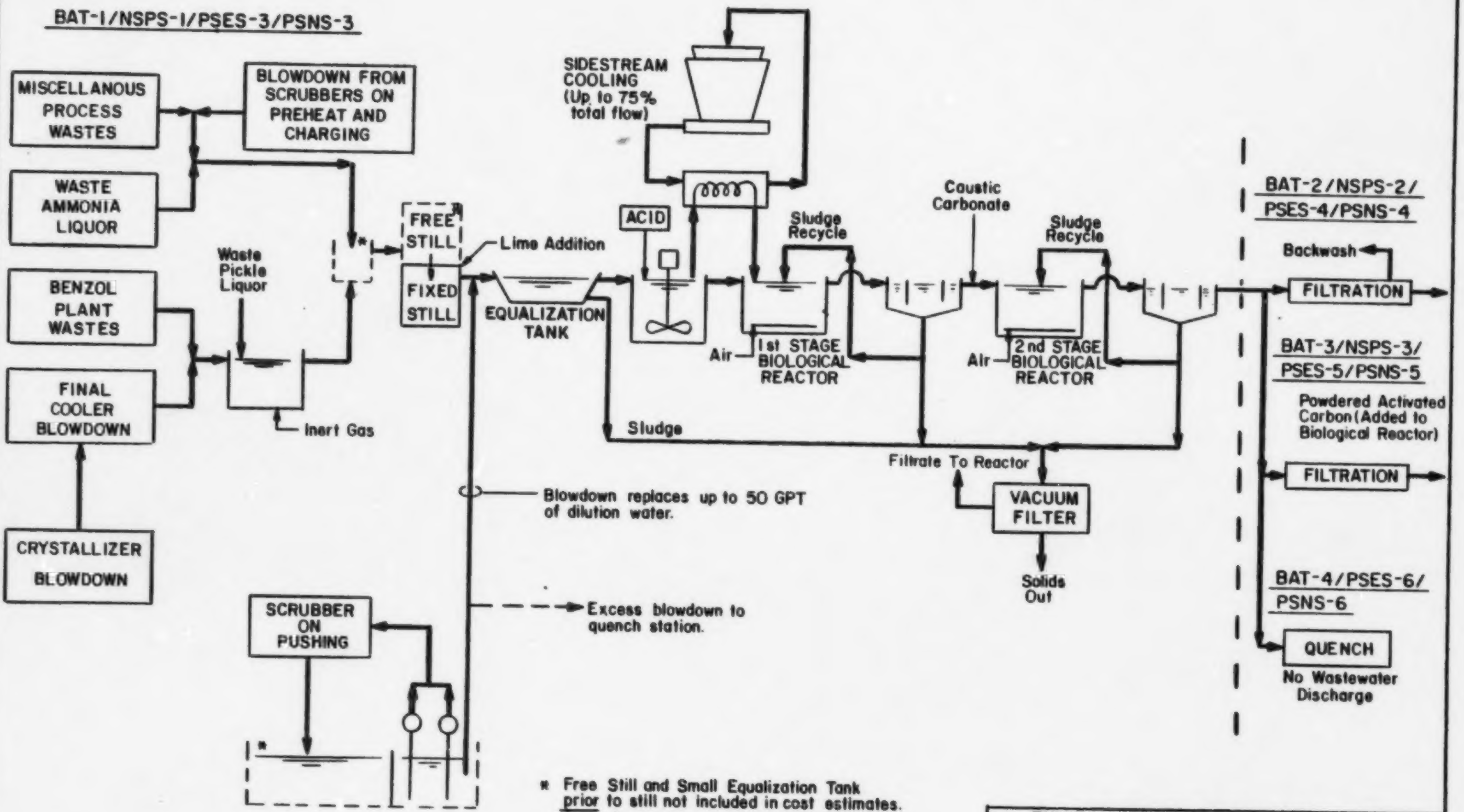
* - Dephenolizer, Free Still and Small Equalization Tank *prior* to not included in cost estimates.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY-PRODUCT COKE MAKING
SUBCATEGORY
PSES & BPT MODEL SUMMARY

Dwn. 12/18/81

FIGURE VIII-1


BAT-1/NSPS-1/PSES-3/PSNS-3
MISCELLANOUS PROCESS WASTES
BLOWDOWN FROM SCRUBBERS ON PREHEAT AND CHARGING
WASTE AMMONIA LIQUOR
BENZOL PLANT WASTES
FINAL COOLER BLOWDOWN
CRYSTALLIZER BLOWDOWN
Waste Pickle Liquor
Inert Gas
*
FREE STILL
FIXED STILL
Lime Addition
EQUALIZATION TANK
SIDESTREAM COOLING (Up to 75% total flow)
ACID
Air
1st STAGE BIOLOGICAL REACTOR
Sludge Recycle
Caustic Carbonate
2nd STAGE BIOLOGICAL REACTOR
Sludge
Filtrate To Reactor
VACUUM FILTER
Solids Out
Blowdown replaces up to 50 GPT of dilution water.
Excess blowdown to quench station.
SCRUBBER ON PUSHING
BAT-2/NSPS-2/PSES-4/PSNS-4
Backwash
FILTRATION
BAT-3/NSPS-3/PSES-5/PSNS-5
Powdered Activated Carbon (Added to Biological Reactor)
FILTRATION
BAT-4/PSES-6/PSNS-6
QUENCH
No Wastewater Discharge

* Free Still and Small Equalization Tank prior to still not included in cost estimates. Basin for pushing scrubber water is costed as part of the air pollution regulation study.

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCT COKE MAKING
SUBCATEGORY
BAT & ADVANCED PSES MODEL SUMMARY

Dwn. 12/18/81

FIGURE VIII-2

COKEMAKING SUBCATEGORY

SECTION IX

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE

The Best Practicable Control Technology Currently Available (BPT) limitations are for the most part, the same as those originally promulgated in June 1974. The June 1974 development document (EPA-440/I-74-024-a; Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Steel Making Segment of the Iron and Steel Manufacturing Point Source Category) describes the methods used to develop the originally promulgated limitations.

Identification of BPT

Based upon the information contained in Section III through VIII of this report, the Agency has determined that the Best Practicable Control Technology Currently Available (BPT) model technology for cokemaking operations includes the following wastewater treatment systems:

A. For By-Product Cokemaking Operations

Blending of wastewater streams from benzol plants, final cooler blowdowns, and miscellaneous process wastewaters with excess ammonia liquor prior to ammonia-N removal in a free ammonia still. Dephenolization of the waste ammonia liquor and other streams is not included. The free still effluent is made alkaline (pH 9-11) with lime and stripped of fixed ammonia in the fixed leg of an ammonia still. Barometric condenser wastewaters from the crystallizer are combined with ammonia still effluents and detained in a storage tank, sedimentation basin or lagoon with a one day retention time. The basin effluent is treated with a small amount of acid, and passed on to an activated sludge basin with extensive aeration. The biotreated effluent is further treated in a clarifier, with vacuum filtration of underflows. The clarifier overflow is discharged to the receiving stream. This model treatment system is illustrated in Figure IX-1. A physical-chemical model treatment system that can be used to achieve the same limitations is illustrated in Figure IX-2. This treatment system is the same as the physical-chemical BPT model treatment system used to develop the prior BPT limitations. This system includes a dephenolizer in lieu of the biological treatment components noted above. For purposes of developing industry-wide cost estimates, the Agency assumed that biological treatment systems would be installed at all plants.

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B. For Beehive Cokemaking Operations

The BPT model treatment system consists of equalization and settling of coke fines in a basin, with total recycle of the basin overflow to quenching operations. A periodic cleanout of the basin is necessary, and recovered solids are recycled to the ovens. Refer to Figure IX-3.

The BPT effluent limitations are summarized in Table IX-1. The BPT limitations are by no means the lowest values attainable by the model technology, but instead represent performance values which can be reasonably attained on a day by day basis. It should be noted that the Agency is not requiring that dischargers use the model technology. Other systems, including the physical-chemical treatment system noted above, can be used as long as the BPT limitations are achieved. The limitations presented in Table IX-1 are 30-day average limitations. The maximum daily effluent limitations are three times the 30-day average limitations except for total suspended solids where a multiplication factor of 1.93 is used. Total investment and annual costs associated with the installation of the BPT model treatment systems are provided in Table VIII-11.

Model Treatment Systems

Both the biological and physical-chemical coke plant wastewater treatment systems illustrated in Figures IX-1 and IX-2, respectively, are widely used in the industry. Hence, the Agency believes these treatment systems are appropriate for establishing the best practicable technology limitations. Aside from disposal of cokemaking wastewaters in coke quenching operations, discharge to POTWs, and, in a few cases, incineration of cokemaking wastewaters, the Agency did not find other treatment technologies in use by the industry.

Model Flow Rate

Because of plant-by-plant variations in by-product recovery operations and air pollution control systems, the Agency used a building block approach in developing the limitations. The by-product cokemaking BPT effluent limitations promulgated in 1974 were based upon a basic flow rate of 730 l/kkg (175 gal/ton), with supplemental allowances for indirect ammonia recovery and qualified desulfurizers. Additional data gathered since promulgation of the original BPT limitations indicate that this flow accurately reflects the average of the best process wastewater flow rates for by-product cokemaking operations affiliated with iron and steel plants at the BPT level of treatment. Slightly higher flows are reported for merchant cokemaking plants. Additionally, 50 gal/ton of dilution water is included to optimize the operation of biological treatment systems for both iron and steel and merchant plants. Refer to Table IX-2 for the model BPT flow rates for the sources of wastewaters regulated by the BPT limitations.

The DCP responses for all active by-product cokemaking facilities indicate that 57% of the plants generate less than 175 gallons of process wastewaters per ton of coke produced, including those wastewater flows disposed of in coke quenching operations. Thus, the basic model flow of 175 gallons per ton used in establishing the BPT limitations is readily demonstrated at a large number of plants. Table IX-3 presents the development of the model flow rates for each wastewater source for cokemaking operations affiliated with iron both and steel plants and merchant cokemaking operations. Note that for most sources of wastewater, the model flow rates for merchant operations are slightly higher than those for iron and steel coke plants.

The Agency determined that the six by-product coke plants that operate indirect ammonia recovery systems should have an allowance for additional flow because of the dilute weak ammonia liquor generated compared to semi-direct recovery systems. Accordingly, an allowance based upon an additional model wastewater flow of up to 251 l/kkg (60 gal/ton) is provided in the BPT limitations for these plants. Likewise, for those plants which include wet desulfurizers, the Agency has included an allowance for additional flow resulting from contaminated condensates. However, not all desulfurizers qualify for these additional flows. Dry adsorption systems with ferric oxide boxes, or extraction methods using solvents which do not increase wastewater volumes are not eligible for the additional allowance. The most common types of desulfurizer contains a potash or soda ash scrubbing system for adsorbing H_2S and a vacuum distillation system (the vacuum carbonate process). These systems are eligible for an additional flow allowance of up to 104 l/kkg (25 gal/ton). This allowance includes the extra steam condensate and slurry associated with treatment of desulfurizer wastes in a fixed ammonia still.

The Agency also provided an allowance of 209 l/kkg (50 gal/ton) for dilution water to optimize the biological treatment process. The Agency found that some operators believe dilution water is required to provide additional microorganisms to the treatment system; others relate dilution water to control of ammonia-N, cyanide, or phenols (4AAP); others believe dilution water is needed to minimize dissolved solids levels; and, others add dilution water to control wastewater and treatment system temperature. Information available to the Agency suggests that temperature control is the most important factor. While other means of temperature control can be implmented to minimize or eliminate the need for dilution water, the Agency believes it is appropriate to provide an allowance of 50 gal/ton. Data for well operated biological treatment systems indicate that 50 gal/ton is an appropriate amount (see Table IX-3). The Agency has determined that, with proper pretreatment and operating control, the BPT limitations can be achieved in biological treatment systems with a dilution flow of 50 gal/ton. At some plants that are not currently achieving the ammonia-N limitations, operating practices might have to be modified to provide for partial nitrification to achieve the ammonia-N limitations.

Thus, considering 50 gal/ton for dilution flow, the BPT limitations are based upon a basic flow rate of 938 l/kkg (225 gal/ton) for iron and steel plants and 1000 l/kkg (240 gal/ton) for merchant plants to allow for fresh water addition to optimize treatment where necessary (see Table IX-3). The allowances noted above for qualifying desulfurizers and indirect ammonia recovery systems are also applicable, as appropriate.

Effluent Quality

The Agency determined that the prior effluent limitations for ammonia-N, total cyanide, and phenols (4AAP) are demonstrated at both biological and physical-chemical treatment systems. However, based upon comments received on the proposed regulation, the Agency found that the prior suspended solids limitations based upon 50 mg/l and the proposed limitations based upon 100 mg/l are not readily achievable with biological treatment systems. The 30-day average BPT suspended solids limitation contained in this regulation is based upon 140 mg/l and the daily maximum value is based upon a concentration of 270 mg/l. The Agency considered effluent data from suspended solids from several biological treatment systems in developing these concentrations but relied primarily upon data from Plant 0868A, where a substantial amount of long term data are available. This plant which includes nitrification of ammonia-N, demonstrates that suspended solids removal from this type of treatment is difficult even in this well operated plant. The Agency recognizes that occasional upsets will occur in biological treatment systems used to treat cokemaking wastewaters and that under such conditions the activated sludge may not settle properly, causing high levels of suspended solids to be discharged. The limitations were developed by excluding concentrations above 300 mg/l from the data base at Plant 0868A. The Agency believes that levels above 300 mg/l do not represent normal operations. Of the relatively few data excluded in this fashion, most were significantly higher than 300 mg/l and would have inordinately biased the limitations to higher levels that are not representative of normal operations. Reference is made to Appendix A of Volume I for additional information.

For beehive operations, no change in the proposed BPT limitations is necessary. The recommended technology and the no discharge condition have been demonstrated on a long-term basis.

Justification for BPT Limitations

A summary of effluent data from sampled plants is presented in Table IX-4. Data are reported for the total wastewater flows leaving the coke plant. For Plant 009, the load shown includes a treated effluent which is disposed of by quenching, in addition to the direct discharge flow.

Most plants achieve the BPT limitations. Where noncompliance is noted, a simple explanation usually accounts for the failure of certain plants to meet the limitations. For example, failure to meet the ammonia-N limitation results from the absence of fixed ammonia removal steps at Plants A, B, 002, 0584F-M and 0684F (quench). For cyanides, untreated barometric condenser flow containing excessive amounts of cyanides is discharged untreated at Plant A. For phenolic compounds, Plants C and 002 provide only minimal control, since the wastewaters are discharged to POTWs. Consequently, most plants demonstrate the ability to achieve the limitations for each limited pollutant. The Agency believes that the model BPT flow rates and effluent quality can be achieved at all coke plants provided properly designed treatment facilities are installed and those systems are well operated. The data shown in Table IX-4 justify the BPT limitations.

TABLE IX-1

BPT EFFLUENT LIMITATION GUIDELINES
COKEMAKING SUBCATEGORY

		BPT Effluent Limitations in kg/kkg (lbs/1000 lbs)[1]					
		TSS	O & G	NH_3-N	Cyanides	Phenols (4AAP)	pH (Units)
A. By-Product Cokemaking							
1. Basic Limitations[2][3]	I&S	0.131	0.0109	0.0912	0.0219	0.00150	6-9
	Merc	0.140	0.0116	0.0973	0.0233	0.00160	6-9
B. Beehive Cokemaking							
1. Basic Limitations		No discharge of process wastewater pollutants to navigable waters.					-

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(1) All values represent 30-day average limitations. Daily maximum limits are three times the limitations shown above for all pollutants except TSS. The daily maximum limitation for TSS is 1.93 times the 30-day average limitation shown above.

(2) Increased loadings, not to exceed 11 percent of the above limitations for iron & steel plants, and 10 percent of the above limitations for merchant plants are allowed for by-product coke plants which have wet desulfurization systems, but only to the extent that such systems generate an increased effluent volume.

(3) Increased loadings, not to exceed 27 percent of the above limitations for iron & steel plants, and 25 percent of the above limitations for merchant plants are allowed for by-product coke plants which have indirect ammonia recovery systems, but only to the extent that such systems generate an increased effluent volume.

TABLE IX-2

BPT MODEL FLOW RATE
BY-PRODUCT COKEMAKING SUBCATEGORY

(All Flows in Gallons/Ton of Coke)

Wastewater Source	Flow Basis BPT Effluent I&S	 Merchant
Waste Ammonia Liquor	32	36
Final Cooler Blowdown	10	12
Barometric Condenser Discharge	75	75
Benzol Plant Wastewater	25	28
Steam & Lime Slurry	13	15
Miscellaneous Sources (leaks, seals, test taps, drains)	20	24
Subtotal - Process Wastewaters	175	190
Dilution to optimize bio-oxidation	50	50
TOTAL FLOW FOR BIOLOGICAL TREATMENT SYSTEMS	225	240
Additional Flow Allowances Provided in the Regulation:		
For Qualified Desulfurizers (Wet), up to:	25	25
For Indirect Ammonia Recovery, up to:	60	60
No Additional Allowances For:		
Air Pollution Control Scrubbers:		
Coal Drying or Preheating - up to 15 GPT Blowdown*	0	0
Charging/Larry Car - up to 5 GPT Blowdown*	0	0
Pushing Side Scrubber - up to 100 GPT Blowdown*	0	0
MAXIMUM TOTAL FLOW	310	325

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*: Up to 50 GPT of dilution water is replaced by blowdowns from air pollution control scrubbers. Any excess blowdown (from pushing only) is disposed of via quenching operations, or treated and reused in the scrubber system.

TABLE IX-3

DEVELOPMENT OF BPT MODEL EFFLUENT FLOW RATES BY-PRODUCT COKEMAKING

Wastewater Source	Flow in GPT	Code No.	GPT	Code No.	GPT
Waste Ammonia Liquor	32 for I&S	0948A	19	0060A	33
		0684H	26	0584C	34
		0684I	26	0112A	35
		0112C	27.8	0584F-M	35
		0112	30	0112B	36
		0684J	30	0448A	37
		0920B	31	0684D	38
		0060	32	0856F	38
		0112D	32	Conf.	<38
			Average of 18 = 32 GPT		
Waste Ammonia Liquor	36 for Merc.	724F	21	0272	36
		0212	26	0024B	43
		0464C	30	0732A	47
		0280B	33	0012A	48
		0174	36		
			Average of 9 = 36 GPT		
Final Cooler Blowdown	10 for I&S	0448A	0.4	0060	7.2
		0856F	1.2	0432B	8.5
		0684A	2.6	0684B	11.3
		0920B	4.2	0112D	12
		0112C	5.4	0112B	13
		0584C	5.6	0584F-M	17.7
		0684I	6.0	0860B	26
		0320	6.2	0384A	32
			Average of 16 = 10.0 GPT		
Final Cooler Blowdown	12 for Merc.	0464C	5.8	0724F	23
		0272	7.0		
			Average of 3 = 11.9 GPT		
Barometric Condenser at Crystallizer (once-through)	75 for I&S and Merc.	0584F-M	20	0248A	79
		0432B	56	0396C	144
			Average of 4 = 75 GPT		
Benzol Plant Wastewaters	25 for I&S	0684A	11	0112B	27
		0112A	13	0060	28
		0448A	15.9	0112C	28
		0920B	21	0112	32
		0432B	23.4	0864A	32
		0060A	24	0584C	33
		0056N	24.3	0432A	33.3
		0948A	25	0024A	34
			Average of 16 = 25.2 GPT		

TABLE IX-3
DEVELOPMENT OF BPT MODEL EFFLUENT FLOW RATES
BY-PRODUCT COKEMAKING
PAGE 2

Wastewater Source	Flow in GPT	Code No.	GPT	Code No.	GPT
Benzol Plant Wastewater	28 for Merc.	0012A	17	0272	26
		0464E	20	0426	32
		0012B	25	0732A	50
		Average of 6 = 28 GPT			
Steam and Lime Slurry (plants with free and fixed stills in operation)	13 for I&S	0060	7.0	0920B	14
		0112C	7.2	0112	15
		0112B	7.3	0112A	15
		0384A	8	0684H	16
		0948C	8	0584F-B(1)	16
		0864A	8.2	0584F-M(1)	16
		0684J	10	0684F(1)	18
		0920F(1)	10.8	0868A	18
		0584C	11	0320	22
		0856F	12		
		Average of 19 = 12.6 GPT			
Steam and Lime Slurry (plants with free and fixed stills in operation)	15 for Merc.	0012A(1)	7.2	0464E	16
		0732A	7.2	0724F	16
		0272	8	0012B(1)	16.8
		0426	16	0174	30.6
		Average of 8 = 14.7 GPT			
Miscellaneous Sources (leaks, seals, test taps, drains, etc.)	20 for I&S	0112B	5	0948C	21
		0112A	8	0684A	22
		0920B	10	0684B	23
		0432A	12	0860B	25
		0384A	17	0584C	32
		0948A	19	0868A	49
		0112D	21		
		Average of 13 = 20 GPT			
Miscellaneous Sources (leaks, seals, test taps, drains, etc.)	24 for Merc.	0732A	21	0280B	28
		0272	22		
		Average of 3 = 24 GPT			
Additional Flow for Wet Desulfurization	25 for I&S and Merc.	0112B	8	0060A	25
		0272	13	0856A	25
		0112A	20	0584F-M	28
		0732A	20	0584C	42
		0280B	21	0584B	53
		0112D	22		
		Average of 11 = 25 GPT			

TABLE IX-3
DEVELOPMENT OF BPT MODEL EFFLUENT FLOW RATES
BY-PRODUCT COKEMAKING
PAGE 3

Wastewater Source	Flow in GPT	Code No.	GPT	Code No.	GPT
Additional Flow for Indirect Ammonia Recovery	60 for I&S and Merc.	0464E	43	Conf.	<60
		0464B	54	0948C	62
		Conf.	<60	0024A	74
		Average of 6 = 59 GPT			
Additional Flow for Optimization of Bio-Oxidation(2)	50 for I&S and Merc.	0584F-M	35	0584F-B	48
		0464E	36	0112A	78
		0426	48		
		Average of 5 = 49 GPT			
Total Plant Effluent (Bio-Oxidation Systems In-Place)	225 for I&S(3)	0920F	143	0012	224
		0868A	146	0584F-B	237
		0112A*	169	0584F-M*	242
		0584C*	199	0856A*	281
		Average of 8 = 205 GPT			
Total Plant Effluent (Bio-Oxidation Systems In-Place)	240 for Merc.(3)	0426	196	0012A	265
		0464E	236		
		Average of 3 = 232 GPT			
Total Plant Effluent (No Bio-Oxidation Systems In-Place; includes all flows leaving plant, even if disposal is via quenching or other means)	175 for I&S(3)	0060F	44	0684F	153
		0448A	60	0432A	158
		0492A	64	0060*	160
		0920B	80	0024A**	173
		0684A	89	0384A	175
		0112D*	102	0946A	182
		0856F	102	0864A	208
		0856N	104	0684I	218
		0112B*	117	Conf.	<220
		0948C**	123	0256E	233
		0060A*	131	0684D	239
		0860B	134	0684B	259
		0948A	135	0860A	269
		0248A	136	0684J	309
		0432B	149	0320	314
		0112C	152		
		Average of 31 = 161 GPT			
Total Plant Effluent (No Bio-Oxidation Systems In-Place; includes all flows leaving plant, even if disposal is via quenching or other means)	190 for Merc.(3)	0464C	33	0280B*	197
		0174	67	0732A*	227
		0464B**	96	0464E**	236
		Conf.**	<100	Conf.**	<250

TABLE IX-3
DEVELOPMENT OF BPT MODEL EFFLUENT FLOW RATES
BY-PRODUCT COKEMAKING
PAGE 4

Wastewater Source	Flow in GPT	Code No.	GPT	Code No.	GPT
Total Plant Effluent (No Bio-Oxidation Systems In-Place; includes all flows leaving plant, even if disposal is via quenching or other means)	190 for Merc.(3)	0272*	112	0656A	255
		0024B	122	0212	256
		0012B	153	0012A	265
		0426	196		
		Average of 15 - 171 GPT			

Conf.: Plant identity is to remain confidential.
* : Indicates that total plant effluent flow includes flow from wet desulfurization.
** : Indicates that total plant effluent flow includes flow from indirect ammonia recovery.

(1) Plant uses caustic soda instead of lime slurry in fixed ammonia still.
(2) Additional flow of 8-30 GPT is added at Plant 0868A. Data from this plant were used to extablish BAT Limitations.
(3) Total plant effluent flows reported by the plants. Not all plants have flow from all wastewater sources listed above or in Table IX-2.

TABLE IX-4

JUSTIFICATION OF BPT LIMITATIONS
COKEMAKING SUBCATEGORY

	Type	Effluent Loads in kg/kkg (lbs/1000 lbs) TSS	O & G	NH_3-N	Cyanide	Phenols (4AAP)	pH (Units)	Flow (Gal/Ton)	C&TT Components
I. By-Product Cokemaking									
BPT[1]	I&S	0.131	0.0109	0.0912	0.0219	0.00150	6-9	225 Bio	NL;ASL;SL-1;NA;A;BOA1;VF
BPT[1]	Merc	0.140	0.0116	0.0973	0.0233	0.00160	6-9	240 Bio	NL;ASL;SL-1;NA;A;BOA1;VF
A. Plant Visit Data From Sampling Survey									
1. Biological Treatment Systems									
B (0112)[2]	I&S	0.0734	0.00113	(0.431)[6]	0.00170	0.000029	7.5	108	E;BOA-1;QD(Part)
008 (0920F)	I&S	0.0249	0.00464	0.0736	0.00142	0.000033	7.5-7.8	139	ASF;ASL;E;CT;BOA-1;CL
2. Other Treatment Systems									
A (0432B)	I&S	0.00325	0.00221	(0.518)[6]	(0.0618)	0.000859	8.6	156	ASF;DP;SB(Part)
C (0384A)[4]	I&S	0.0173	0.00322	0.0657	0.0115	(0.0371)	(9.5-11.8)	40.6	ASF;DP;ASL;SB;QD(Part)
D (0272)	Merc	0.0645	0.00149	0.0137	0.0149	0.000616	(11.7)	28.8	ASF;DS;DP;ASL
002 (0464C)[4]	Merc	0.00090	0.00599	(0.730)[6]	0.00243	(0.0126)	8.9-9.0	35.9	DP;CLA;E
009 (0684F)[3][5]	I&S	0.0121	0.00363	0.0859	0.00907	0.000304	(8.8-9.9)	96.7	E;DP;GF;FDSP;ACG;ASF;ASC(Part); E;GF;FDSP;ACG;QT(Part)
B. Long-term Data Reported by Plants via D-DCP									
1. Biological Treatment Systems									
0012A	Merc	(0.163)	(0.0403)	0.0587	0.00436	0.00042	7.6	402	ASF;ASC;BOA-1;CL;QD(Part)
0584F-B	I&S	(0.137)	0.00408	(0.106)	0.00211	0.000073	7.7	287	ASF;ASC;BOA-1;CL
0584F-M	I&S	NR	NR	(0.306)[6]	NR	0.000243	6.7	208	ASF;BOA-1;CL;QD(Part)
2. Carbon Adsorption System									
0684F-Direct	I&S	0.0173	0.00231	(0.225)[6]	0.00984	0.0000765	(10.7)	99	E;DP;GF;FDSP;ACG;ASF;ASC
0684F-Quench	I&S	0.0103	0.00327	(0.164)[6]	0.0130	0.00000187	(9.3)	112	E;GF;FDSP;ACG;QT
0684F-Total[5]	I&S	0.0276	0.00558	(0.389)[6]	(0.0228)	0.0000784	(9.3-10.7)	211	E;DP;GF;FDSP;ACG;ASF;ASC(Part); E;GF;FDSP:ACG;QT(Part)

TABLE IX-4
JUSTIFICATION OF BPT LIMITATIONS
COKEMAKING SUBCATEGORY
PAGE 2

	Type	Effluent Loads in kg/kkg (lbs/1000 lbs) TSS	O & G	NH_3-N	Cyanide	Phenols (4AAP)	pH (Units)	Flow (Gal/T	C&TT Components
II. Beehive Cokemaking		No discharge of process wastewater pollutants to navigable waters							SL;RTP100
Plant Visit Data From Sampling Survey									
E		(0.0736)	(0.00041)	(0.00041)	(0.000008)	(0.000029)	(7.1)	490	SL;OT
F		No discharge of process wastewater pollutants to navigable waters					0		SL;RTP100
G		No discharge of process wastewater pollutants to navigable waters					0		SL;RTP100

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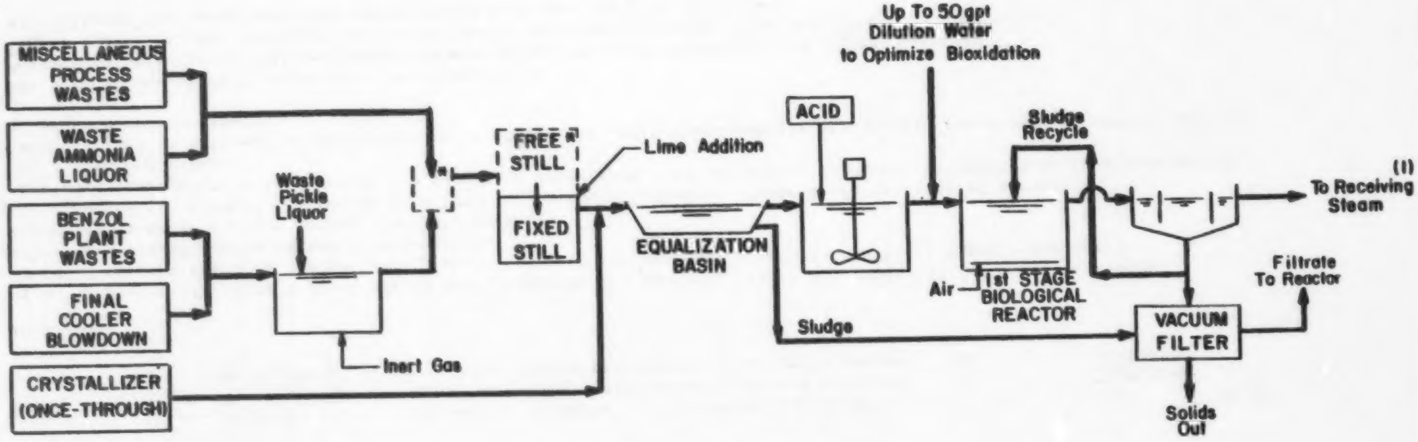
(1) Add up to 11 percent for iron & steel plants and 10 percent for merchant plants for qualified (wet) desulfurizers; add up to 27 percent for iron & steel plants and 25 percent for merchant plants for indirect ammonia recovery.
(2) Plant has been significantly upgraded since survey.
(3) Plant provides more advanced treatment than BPT system.
(4) Plant discharges its treated wastewater to a POTW for further treatment. Phenols are not treated on-site.
(5) Data includes load which is disposed of via quenching operations. Actual direct discharge effluent load is approximately half of the values given.
(6) High ammonia load in effluent primarily due to incomplete or ineffective ammonia stripping. Fixed ammonia removal step is often inactive or non-existent.

NOTES: For definitions of C&TT components, see Table VII-1.
Numbers in parentheses indicate nonachievement of the desired limitations for given pollutant.
(Part) indicates that only part of the wastewater receives treatment from the given C&TT components.
NR indicates that plant provided no long-term data for the given pollutant.


MISCELLANEOUS PROCESS WASTES
WASTE AMMONIA LIQUOR
BENZOL PLANT WASTES
FINAL COOLER BLOWDOWN
CRYSTALLIZER (ONCE-THROUGH)
Waste Pickle Liquor
Inert Gas
*
FREE STILL *
FIXED STILL
Lime Addition
EQUALIZATION BASIN
Sludge
ACID
Up To 50 gpt Dilution Water to Optimize Bioxidation
Air
1st STAGE BIOLOGICAL REACTOR
Sludge Recycle
(1) To Receiving Steam
Filtrate To Reactor
VACUUM FILTER
Solids Out

(1) Refer to Table IX-1 for effluent loads. Flows are based on 938 l/kkg (225 gal./ton) for Iron & Steel plants, and 1,000 l/kkg (240 gal./ton) for Merchant Plants.

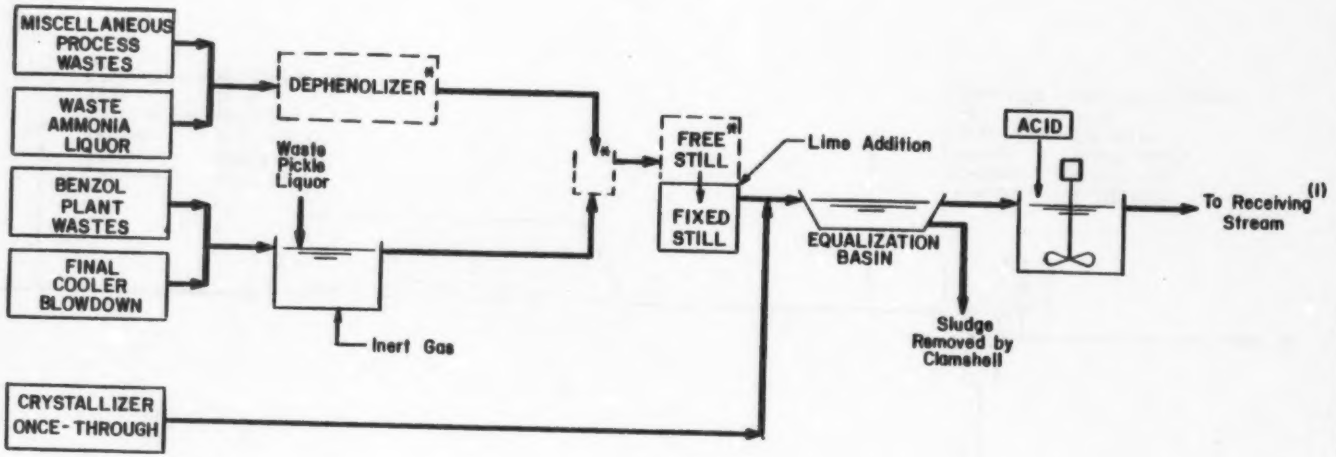
* - Free Still and Small Equalization Tank prior to still not included in cost estimates.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY-PRODUCT COKE MAKING
SUBCATEGORY
BIOLOGICAL TREATMENT SYSTEM
BPT MODEL

Dwn. 12/18/81

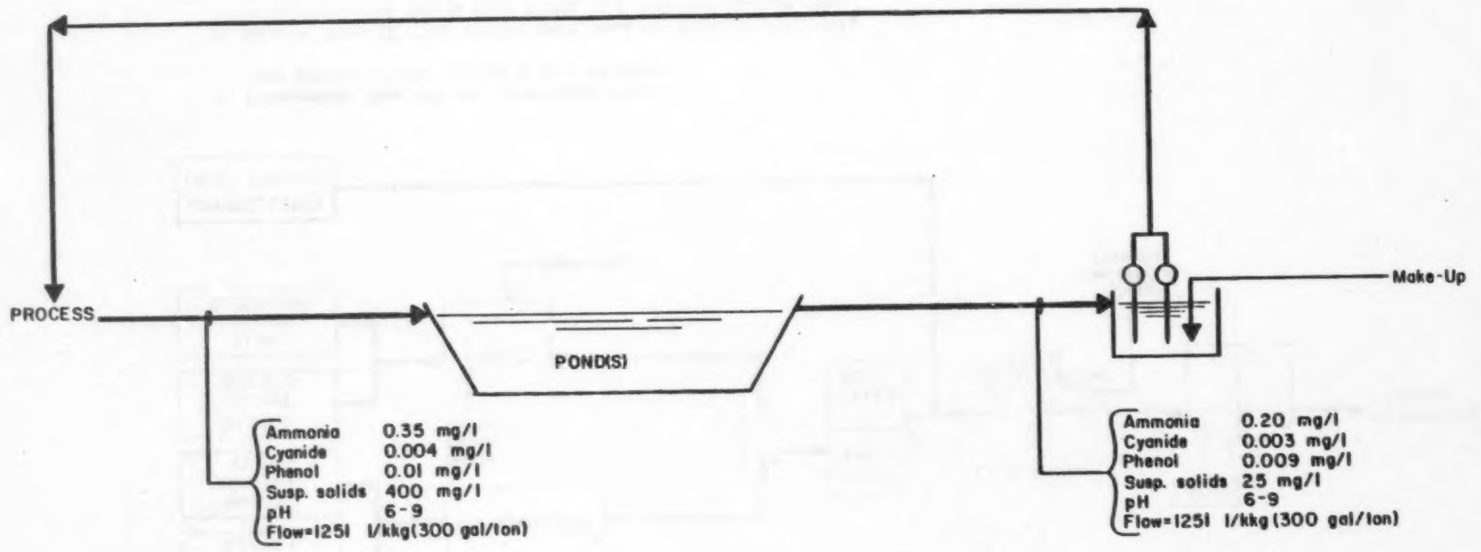
FIGURE IX-1


MISCELLANEOUS PROCESS WASTES
WASTE AMMONIA LIQUOR
BENZOL PLANT WASTES
FINAL COOLER BLOWDOWN
CRYSTALLIZER ONCE-THROUGH
DEPHENOLIZER*
Waste Pickle Liquor
Inert Gas
*
FREE STILL*
FIXED STILL
Lime Addition
EQUALIZATION BASIN
Sludge Removed by Clamshell
ACID
To Receiving Stream(1)

* Dephenolizer, Free Still and Small Equalization Tank prior to still not included in cost estimates.

(1) Refer to Table IX-1 for effluent loads. Flows are based on 730 l/kkg (175 gal./ton) for Iron & Steel Plants, and 792 l/kkg (190 gal./ton) for Merchant Plants.

ENVIRONMENTAL PROTECTION AGENCY			
STEEL INDUSTRY STUDY BY-PRODUCT COKE MAKING SUBCATEGORY PHYSICAL-CHEMICAL TREATMENT SYSTEM BPT MODEL			
Dwn. 12/21/81			FIGURE - IX - 2


PROCESS
POND(S)
Make-Up
Ammonia 0.35 mg/l
Cyanide 0.004 mg/l
Phenol 0.01 mg/l
Susp. solids 400 mg/l
pH 6-9
Flow=1251 l/kkg(300 gal/ton)
Ammonia 0.20 mg/l
Cyanide 0.003 mg/l
Phenol 0.009 mg/l
Susp. solids 25 mg/l
pH 6-9
Flow=1251 l/kkg(300 gal/ton)

— BPT MODEL

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BEEHIVE COKEMAKING SUBCATEGORY
BPT MODEL

DWN.5-25-78

FIGURE IX-3

COKEMAKING SUBCATEGORY

SECTION X

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE

Introduction

The effluent limitations to be achieved by July 1, 1984 are to specify the degree of effluent reduction attainable through the application of the Best Available Technology Economically Achievable (BAT). BAT is to be determined by identifying the very best control and treatment technology employed within the industrial subcategory, or where it is readily transferable from one industry to another, such technology may be identified as BAT. Four BAT treatment alternatives were considered for by-product cokemaking. For beehive operations, BAT is identical to the BPT limitations described in Section IX.

As indicated in Section V, significant changes in air emission controls and wastewater control and treatment technology have produced several treatment options for by-product cokemaking operations. Because of the number of choices available, the Agency decided to use a building block approach in developing the BAT limitations as it did with the BPT limitations. Flow rates from certain wastewater sources can be minimized by recycling or reuse where appropriate, or by process changes which eliminate or substantially reduce wastewater volumes, such as replacing barometric condensers with surface condensers. The approach contained in the original development document EPA-440/1-74-024a (recycling barometric condenser wastewaters to achieve a 72 gal/ton flow reduction from that source alone) is applicable to 15 of the 59 plants responding to EPA questionnaires and is currently practiced by seven plants, which have an average condenser blowdown flow of 5.2 gal/ton. The other 44 plants have no wastewaters from this source.

Although wastewater disposal by coke quenching is widely practiced, more stringent air pollution control requirements mitigate against continued widespread use of this practice. Consequently, the Agency believes it would be inappropriate to establish BAT limits at zero discharge on that basis. For costing purposes, the Agency assumed that on-site biological treatment to achieve the BPT and BAT limitations would be installed at those plants. Also, the water used in scrubbers associated with control of atmospheric emissions from oven charging and pushing require control and treatment. Recycle of the scrubber waters can be used to minimize the volume requiring treatment. However, the blowdowns from these systems must be treated prior to discharge.

Model BAT Flow

The flows of the model treatment system for by-product cokemaking operations are based upon values shown in Table X-1. Plants which demonstrate the BAT model flow for each wastewater source and the total BAT model flow are listed in Table X-2.

The limitations include an allowance for additional process wastewater flow for those plants practicing indirect ammonia recovery. These six plants produce about 6% of the annual coke tonnage. They qualify for supplemental load allowances based on 251 l/kkg (60 gal/ton) flow rates. The desulfurizer allowances listed in Section IX are also included in the BAT limitations.

Based upon the performance at several well operated plants, the Agency provided an allowance of up to 50 gal/ton for fresh water dilution to optimize biological treatment at the BPT level (see Table IX-3). At the BAT level, this dilution water is replaced by settled pushing emission control system blowdowns or other wastewaters that are not highly contaminated. The adverse impacts of temperature changes can be controlled by installing indirect cooling systems or by allowing sufficient retention and equalization time prior to biological treatment. Providing suitable pretreatment and equalization of the ammonia liquor prior to biological treatment also minimizes the amount of "dilution" which may be necessary to protect the microorganisms. Where sufficient wastewater volumes from other less aggressive sources exist, they should replace all or part of the 209 l/kkg (50 gal/ton) dilution which was included in the BAT limitations. The Agency provided 50 gal/ton in the model treatment system flow rate for this purpose.

Identification of BAT Alternatives

The model wastewater flows used as a basis for BAT cost estimates are summarized in Table X-1. The pollutant levels which the BAT alternative treatment system can achieve are discussed below on a pollutant-by-pollutant basis. The alternative systems are described in Table VIII-4 and schematics of the four BAT alternative treatment models are shown in Figure VIII-2. The BAT limitations are set out in Table X-3 (Alternative No. 1).

The four BAT alternative treatment systems for by-product cokemaking operations are described below:

A. BAT Alternative 1

The first step is the recycle of crystallizer wastewaters, if any, to minimize the flow to be treated. The total wastewater flow is treated in a two-stage or extended biological system. For costing purposes, a second stage biological system, complete with a separate clarifier was included. This system is diagrammed as Alternative 1 in Figure VIII-2. Individual component costs are shown in Table VIII-6 for iron and steel plants and in Table VIII-7 for merchant plants.

B. BAT Alternative 2

Filtration of the effluent from the BAT Alternative 1 model treatment system is included to minimize carryover of suspended solids and any toxic pollutants that may be entrained in the solids. This system appears as Alternative 2 in Figure VIII-2.

C. BAT Alternative 3

Alternative 2 may be upgraded to provide better control of toxic organic pollutants and ammonia removal by the addition of powdered activated carbon to the biological reactors. Refer to Figure VIII-2, Alternative 3 for a diagram of the system. Limited data indicate that single stage systems, with or without powdered activated carbon can produce comparable effluent quality. However, the Agency does not have sufficient data to establish limitations based upon that technology.

D. BAT Alternative 4

The treated effluent from the above biological alternative systems may be disposed of by coke quenching where impacts on air pollution can be tolerated. Although this approach is not recommended it provides a means of achieving zero discharge. Refer to Figure VIII-2, Alternative 4 for the treatment system diagram, and to Tables VIII-6 and VIII-7 for component costs.

Selection of a BAT Alternative

The Agency selected BAT Alternative No. 1, depicted in Figure X-1, as the model treatment system upon which the BAT limitations are based. This technology is practiced in this subcategory on a full-scale basis. The two-step or extended biological oxidation system is currently installed at four by-product coke plants. However, all of these systems are not operated to achieve the BAT limitations. The Agency has determined that the biological treatment system installed at Plant 0868A is the best treatment system. In making this determination, the Agency considered the coke production facility at Plant 0868A; the by-product recovery facilities; air pollution control systems; untreated wastewater characteristics; the geographical location of the plant; and the design and operation of the treatment facilities. The Agency found no factors which it believes make this plant unique or not suitable for designation as the best plant.

While filtration of biological treatment system discharges is practiced at Plant 0856A, the overall performance of the filtration system at this plant has not been satisfactory because of design and mechanical problems. Hence, the Agency has not included filtration in the selected BAT model treatment system. BAT Alternative No. 3, which provides for the addition of powdered activated carbon, has been limited to short-term testing on a pilot scale, and shows promise of marginal reductions in total pollutant loads. Alternative 4 cannot be applied in most cases because of its impact on air pollution.

Currently, two plants are operating advanced physical/chemical wastewater treatment systems that include technologies other than bioxidation. Mixed media pressure filtration and granular activated carbon adsorption using fixed bed columns are provided at both of these plants (0684F and 0732A). The latter plant also is equipped with alkaline chlorination. The Agency has promulgated separate BAT limitations for those cokemaking operations with full scale granular activated carbon columns installed prior to the proposal of these limitations. These limitations are similar to the BAT limitations for other by-product cokemaking plants, except for ammonia-N, phenols (4-AAP) and total cyanide. Refer to Table X-3 for the physical/chemical BAT effluent limitations and to Figure X-2 for the model treatment system. The limitations can be achieved by treatment systems consisting of flow minimization (as in BAT Alternative No. 1 above), fixed ammonia stripping, followed by pressure filtration and adsorption on fixed beds of granular activated carbon. Refer to Table VIII-8 for cost information.

Control and Treatment of Pollutants Using BAT Technology

Appendix C of Volume I presents effluent quality data for each BAT alternative technology. The Agency evaluated the impact of BAT model treatment system components on toxic pollutants using data obtained during sampling surveys at Plants 003, 008, 009, together with long-term and special verification pilot scale study data from Plants 0868A and 0732A, respectively. The treatment system at Plant 0732A has only been recently installed, thus long-term data are not available. Plant 0868A represents BAT Alternative 1, while Plants 0732A and 0684F are the two physical/chemical treatment systems. Sufficient monitoring data are available to determine treatment system impacts on toxic pollutants (Table X-4).

As discussed in Section VII and summarized in Table VII-3, the many toxic organic pollutants identified in wastewaters from by-product cokemaking can be controlled by treating those pollutants listed in the BPT limitations and, in addition, benzene, naphthalene, and benzo(a)pyrene. The Agency selected these toxic organic pollutants and phenols (4-AAP) to serve as indicators for volatile, acid, and base/neutral toxic organic pollutants.

A discussion of the reductions achieved by the BAT model treatment system on a pollutant by pollutant basis follows. Table X-5 compares actual plant performance with the BAT effluent limitations.

Ammonia-N

The BAT limitations for ammonia-N are achieved at Plant 0868A with biological treatment. During the toxic pollutant survey, the discharge (0.77 mg/l, 201 gal/ton) amounted to less than 5 percent of the BAT limitation. Long term data provided for the plant show consistent compliance with the 30-day average and daily maximum limitations. From April, 1979 through May, 1981 all monthly average values with one exception (4.4% over the limit) were within the 30-day average BAT limitation. Daily maximum concentrations were exceeded for only one day during that twenty-six month period. These observations were confirmed during seven weeks of EPA verification sampling on-site between October, 1979 and February, 1980. Daily maximum discharges never exceeded 45% of the BAT limitation, and monthly averages for October, January, and February were at <1%, 55%, and 92% of the BAT 30-day average limitation, respectively. Daily analyses reported by the company covering the same period indicate the same high degree of compliance with the daily maximum limitation. This successful ammonia-N load reduction is achieved by passing all wastewaters through free and fixed stills, an aerated sludge lagoon with two separate compartments, and a clarifier. The ammonia stills reduce ammonia levels from 2,400 mg/l in the raw liquor to 60 mg/l in the combined feed to biological treatment. The ammonia content is further reduced by the later treatment.

With one exception, the ammonia-N limitations were not achieved at the remaining plants. These plants do not conform to the BAT model treatment facility, or are not operated to achieve a high level of ammonia-N removal. Cokemaking wastewaters from Plant C are discharged to a POTW, and no other treatment for ammonia is provided except the free and fixed stills. Plant 0920F has a treatment sequence similar to Plant 0868A, however, the benzol plant wastewaters are not pretreated for ammonia-N. Although the ammonia liquor has only 33 mg/l of ammonia-N after stripping, the addition of raw benzol plant wastewaters raises the ammonia-N concentration in the feed to the biological treatment system to 202 mg/l. Biotreatment reduced the ammonia-N content to 127 mg/l in the effluent. At the time during which Plant 0920F was sampled (Sept. 6-9, 1977), only one of the two aeration basins was in use. The Agency believes that with proper pretreatment and full operation of the biological treatment system at this plant, the ammonia-N limitations could be achieved.

Monitoring data for Plant 0684F (physical/chemical treatment) indicates an ammonia-N discharge of 2.7 times the applicable 30-day average BAT limitation, at 0.0859 kg/kkg. This includes a portion of the treated wastewater which is currently evaporated by coke quenching and not passed through the ammonia-N still. The actual ammonia-N load discharged directly is 0.0568 kg/kkg, which exceeds the BAT 30-day average limitations for physical/chemical treatment systems by 76%. Although the treatment system is designed to strip fixed ammonia following caustic addition, both toxic survey and long-term data indicate this reaction is not carried to completion. During EPA's sampling visit, the ammonia-N concentration was reduced from 7750 mg/l to 290 mg/l in the still, but pH values never exceeded 9.0 in the still effluent, indicating that the 290 mg/l could have been further reduced. Long- term data reported for the plant covering the period from May, 1979 through May, 1981 are in the form of weekly averages. Ammonia-N concentrations in the still effluent averaged 130 mg/l but the range was 11.8 mg/l to 860 mg/l. Twenty out of twenty-five monthly averages exceed the 75 mg/l used as the basis for 30-day average limitations for physical/chemical treatment systems. When ammonia-N discharges based upon the low discharge flows reported for Plant 0684F are calculated, the limitations are exceeded for six of the twenty-five months. Moreover, 31% of the individual results exceeded the daily maximum concentration, even though results were reported weekly, not daily. This plant can attain the BAT limitation for ammonia-N for physical/chemical plants by improving fixed ammonia removal efficiency.

In summary, the Agency believes that the BAT limitations for ammonia-N can be achieved at all plants equipped with the model BAT treatment systems or equivalent.

Total Cyanide

The BAT limitations for cyanide are achieved at plants with biological treatment systems. For Plant 0868A, daily analyses for the period November 1977 through May 1981 demonstrate compliance, averaging 2.75 mg/l on a year-round basis. For the 43 months for which daily analyses are available, one monthly average exceeded the 30-day average limitation. Daily maximum limitations were exceeded only twice in 43 months. This high level of compliance continued through the seven week EPA verification survey (October 1979 through February 1980). Overall average total cyanide loads for this survey were at 48% of the 30-day average limitations and none of 21 daily values exceeded the daily maximum limitation.

Both long term data (six months) and data obtained during the EPA toxic pollutant survey for Plant 0920N also demonstrate the achievability of the 30-day average and daily maximum limitations for cyanide. The Agency believes that the cyanide limitations can be achieved at all coke plants equipped with the model BAT treatment system or equivalent.

Phenols (4AAP)

Data obtained during the sampling surveys demonstrate the achievability of the maximum daily BAT limitation for phenols (4 AAP). Three biological treatment plants were discharging less than 50% of the BAT daily maximum limitations. Moreover, long-term data covering 43 months of operation at Plant 0868A demonstrate consistent attainment of the 30-day average limitation. During that period, the overall average of all monthly averages was 42% of the 30-day average limitation. The limitations were exceeded during one month in 43 months, the first month of operation. The daily maximum limitation has been exceeded only ten times out of 1,237 observations. During the seven-week verification study at this plant, effluent concentrations of phenols (4AAP) averaged 62% of the 30-day average limitation, and no individual result exceeded the daily maximum limitation.

The primary treatment system component in the physical/chemical systems is activated carbon adsorption. Phenols (4AAP) in the wastewaters flowing into the two separate activated carbon systems at Plant 0684F were effectively reduced. During the EPA survey, the concentration in the waste ammonia liquor was reduced from 90 mg/l to 0.058 mg/l; and, the concentration in all other wastewaters was reduced from 1,550 mg/l to 0.168 mg/l. Long-term data from the same plant show average effluent loads of 0.000077 kg/kkg discharged directly and <0.000002 kg/kkg disposed of by quenching. Direct discharge data are based upon 102 analyses. Five of the individual values exceed the concentration used to develop the daily maximum limitations; however, the limitation was exceeded only twice.

The Agency believes that the phenols (4AAP) BAT limitations can be achieved at all coke plants.

Benzene

The toxic pollutant plant sampling visits and the verification program at Plant 0868A are the primary sources of data for benzene, (refer to Table VII-3 for data for toxic organic pollutants). Short-term data indicated that the BAT limitations for benzene are acheived at Plant 0684A by carbon adsorption, and at Plant 0868A by biological treatment. Monitoring data from the seven week (21 sampling days) verification sampling at Plant 0868A indicate that the BAT limitations for benzene were consistently achieved. Daily discharges never exceeded 42% of the daily maximum limitation, and averaged less than 18%. Also, pilot plant data from Plant 0732A indicate that the physical/chemical treatment system removes benzene effectively. The effluent concentrations from the carbon columns averaged <0.03 mg/l consistently. This approaches the performance of the full-scale system installed at Plant 0684F where the benzene concentration in the discharge was found to be less than 0.01 mg/l.

Naphthalene

The BAT naphthalene limitation was achieved at three of the four plants surveyed for toxic pollutants. Biological systems at Plants 0868A and 0920F attain "none detected" and <0.000002 kg/kkg respectively. A similar value is achieved at Plant 0684F.

Pilot scale data for Plant 0732A (physical/chemical) show carbon column effluents at <0.01 mg/l, often at "none detected". Verification data for Plant 0868A show that the 21 daily observations were all less than the daily maximum BAT limitation. Based upon these data, the Agency concludes that the BAT limitation for naphthalene is being achieved using the BAT model treatment systems. The Agency believes the naphthalene BAT limitations can be achieved at all coke plants.

Benzo(a)pyrene

The daily maximum limitation for benzo(a)pyrene was achieved at all four of the coke plants surveyed by the Agency. Discharges of 0.000011 kg/kkg and "none detected" were recorded for biological treatment at Plants 0868A and 0920N, respectively; and, a level of less than 0.00001 kg/kkg was recorded at Plant 0684F with physical/chemical treatment. Pilot plant data for the activated carbon system at Plant 0732A showed <0.01 mg/l or "none detected."

Verification data for Plant 0868A were consistently below the daily maximum concentration value except for a two-day outage in January 1980. The daily maximum limitation was exceeded on only one day. Pilot filtration data indicate this outage was due to benzo(a)pyrene which had been adsorbed on activated sludges, and was carried out with abnormally high concentrations of TSS (500-1400 mg/l). Post filtration of the BAT Alternative No. 1 effluent could be used to minimize the discharge of toxic organic pollutants during periods of treatment system upsets.

The Agency believes that BAT limitations for benzo(a) pyrene can be achieved at all coke plants.

Justification for BAT Effluent Limitations

Table X-5 presents a summary of actual plant performance data with the BAT effluent limitations. These data indicate that well designed and well operated treatment systems can be used to achieve all BAT effluent limitations.

TABLE X-1

BAT FLOW SUMMARY
BY-PRODUCT COKEMAKING SUBCATEGORY

(All Flows in Gallons/Ton of Coke)

Wastewater Source	Flow Basis BAT Effluent I&S	 Merchant
Waste Ammonia Liquor	32	36
Final Cooler Blowdown	10	12
Barometric Condenser Blowdown	3	5
Benzol Plant Wastewater	25	28
Steam & Lime Slurry	13	15
Miscellaneous Sources (leaks, seals, test taps, drains)	20	24
Subtotal - Process Wastewaters	103	120
Dilution to optimize bio-oxidation	50*	50*
BASIC TOTAL FLOW	153	170
Additional Flow Allowances Provided in the Regulation:		
For Qualified Desulfurizers (Wet), up to:	25	25
For Indirect Ammonia Recovery, up to:	60	60
No Additional Allowances For:		
Air Pollution Control Scrubbers:		
Coal Drying or Preheating - up to 15 GPT Blowdown*	0	0
Charging/Larry Car - up to 5 GPT Blowdown*	0	0
Pushing Side Scrubber - up to 100 GPT Blowdown*	0	0
MAXIMUM TOTAL FLOW	238	255

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*: Up to 50 GPT of dilution water is replaced by blowdowns from air pollution control scrubbers. Any excess blowdown (from pushing only) is disposed of via quenching operations, or treated and reused in the scrubber system.

TABLE X-2

DEVELOPMENT OF BAT MODEL EFFLUENT FLOW RATES BY-PRODUCT COKEMAKING

Wastewater Source	Flow Basis in GPT		Plants Which Demonstrate BAT Flow			
	I&S	Merc.	Code No.	GPT	Code No.	GPT
Waste Ammonia Liquor	32	36	Same as BPT. Refer to Table IX-3.			
Final Cooler Blowdown	10	12	Same as BPT. Refer to Table IX-3.			
Barometric Condenser Blowdown(1)	3(4%)	5(7%)	0448A	<1(<1%)	0112D	6.6(2.6%)
			0856F	2.4(<1%)		
Benzol Plant Wastewaters	25	28	Same as BPT. Refer to Table IX-3.			
Steam and Lime Slurry(2)	13	15	Same as BPT. Refer to Table IX-3.			
Miscellaneous Sources	20	24	Same as BPT. Refer to Table IX-3.			
Additional Flow for Bio-Oxidation Optimization	50	50	Same as BPT. Refer to Table IX-3.			
Additional Flow for Wet Desulfurization	25	25	Same as BPT. Refer to Table IX-3.			
Additional Flow for Indirect Ammonia Recovery(3)	60	60	Same as BPT. Refer to Table IX-3.			
Total Plant Effluent (Bio-Oxidation in Place)	153	170	0920F	143	0112A	169(4)
			0868A	146		
Total Plant Effluent (No bio-oxidation in place; includes total flows leaving plant)	103	120	0464C*	33	0464B*	96
			0060F	44	0112D	102
			0448A	60	0856F	102
			0492A	64	0856N	104
			0174*	67	0272*	112
			0920B	80	0024B*	122
			0684A	89	0948C	123(5)

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*Indicates merchant plant.

(1) Numbers in parenthesis represent % of applied rate going to blowdown.

(2) Includes steam from free and fixed ammonia stripping, plus water used to make lime slurry or caustic solutions. Even though free ammonia removal is considered to be a recovery process and not pollution control, the steam condensates are included among the wastewaters requiring treatment.

(3) Plants which practice indirect ammonia recovery qualify for 60 additional GPT ammonia liquor allowance over and above the 32 to 36 GPT which all plants receive.

(4) Includes 20 GPT additional allowance for wet desulfurization.

(5) Includes up to 60 GPT additional allowance for indirect ammonia recovery.

TABLE X-3

BAT EFFLUENT LIMITATION GUIDELINES
COKEMAKING SUBCATEGORY

		BAT Effluent Limitations in kg/kkg (lbs/1000 lbs)(1)					
		NH3-N	Cyanide	Phenols (4 AAP)	Benzene(2)	Naphthalene(2)	Benzo(a)pyrene(2)
I. BY-PRODUCT COKEMAKING							
A. Alternative 1:*							
1. Basic Limitation(3)(4)	Iron & Steel	0.0160	0.00351	0.0000319	0.0000319	0.0000319	0.0000319
	Merchant	0.0177	0.00390	0.0000355	0.0000355	0.0000355	0.0000355
Physical/Chemical(3)	Iron & Steel	0.0322	-	0.0000430	0.0000215	0.0000215	0.0000215
	Merchant	0.0375	-	0.0000501	0.0000250	0.0000250	0.0000250
B. Alternative 2:							
1. Basic Limitation(3)(4)	Iron & Steel	0.0160	0.00319	0.0000319	0.0000319	0.0000319	0.0000319
	Merchant	0.0177	0.00355	0.0000355	0.0000355	0.0000355	0.0000355
C. Alternative 3:							
1. Basic Limitation(3)(4)	Iron & Steel	0.0128	0.00319	0.0000160	0.0000191	0.0000191	0.0000191
	Merchant	0.0142	0.00355	0.0000177	0.0000213	0.0000213	0.0000213
D. Alternative 4:							
1. Basic Limitation	Iron & Steel Merchant		No Discharge of Process Wastewater Pollutants to Navigable Streams				
II. BEEHIVE COKEMAKING			No Discharge of Process Wastewater Pollutants to Navigable Streams (Same as BPT)				

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(1) 30-Day average BAT limitations. Daily maximum values are twice the limitations stated for phenols (4 AAP) and for NH_3-N (Physical/chemical systems), 1.8 times the limitations stated for cyanide, and 3.4 times the limit for NH_3-N (biological systems).

(2) Daily maximum limitation only. No 30-day average limitation.

(3) Increased loadings, not to exceed 16 percent of the above limitations for iron & steel plants and 15 percent of the above limitations for merchant plants (24 percent and 21 percent respectively for physical/chemical systems), are allowed for by-product coke plants which have wet desulfurization systems, but only to the extent that such systems generate an increased effluent volume.

(4) Increased loadings, not to exceed 39 percent of the above limitations for iron & steel plants and 35 percent of the above limitations for merchant plants are allowed for by-product coke plants which have indirect ammonia recovery systems, but only to the extent that such systems generate an increased effluent volume.

* : Selected BAT Alternative

TABLE X-4

IMPACT OF SELECTED BAT TECHNOLOGIES ON TOXIC POLLUTANTS

All concentrations in micrograms/liter.

	Physical-Chemical Alternative(1)				Biological Alternative(2)			
Pollutant	BAT Feed	Gas Flot.	Filtration	Carbon Ads.	BAT Feed	2-Stage Biotreatment	Clarifier	Filtration
Toxic Organic								
Acenaphthene	20	15	7	5	15	10	2	2
Acenaphthylene	2,750	2,750	2,400	5	100	10	5	5
Acrylonitrile	750	550	400	200	25	ND	ND	ND
Benzene	40,000	40,000	40,000	10	10,000	25	10	10
Benzo(a)anthracene	500	400	120	5	100	25	2	2
Benzo(a)pyrene	400	400	300	10	150	20	10	<10
Chloroform	20	20	20	20	20	20	20	20
Chrysene	750	300	300	10	160	10	10	10
2,4-Dimethylphenol	25	35	35	ND	2,000	25	ND	ND
Ethylbenzene	25,000	25,000	18,000	50	200	10	2	2
Fluoranthene	1,500	1,000	750	10	50	10	2	2
Fluorene	700	600	500	5	20	10	2	2
Naphthalene	35,000	25,000	20,000	10	50	10	2	2
2-Nitrophenol	40	30	20	5	ND	ND	ND	ND
Phenol	80,000	35,000	30,000	40	24,000	25	15	10
Pyrene	1,750	1,750	750	7	60	25	10	10
Toluene	30,000	25,000	20,000	7	4,000	25	10	10
Xylene	200,000	200,000	150,000	5	ND	ND	ND	ND

TABLE X-4
IMPACT OF SELECTED BAT TECHNOLOGIES ON TOXIC POLLUTANTS
PAGE 2

Pollutant	Physical-Chemical Alternative[1]				Biological Alternative[2]			
	BAT Feed	Gas Flot.	Filtration	Carbon Ads.	BAT Feed	2-Stage Biotreatment	Clarifier	Filtration
Toxic Metals and Cyanide								
Antimony	400	400	300	200	150	150	125	50
Arsenic	200	160	150	100	160	125	125	70
Beryllium	*	*	*	*	10	2	2	2
Cadmium	10	10	10	10	15	10	10	<10
Chromium	ND	ND	ND	ND	25	20	10	<10
Copper	50	25	25	20	25	20	20	<10
Cyanide	30,000	25,000	25,000	25,000	75,000	3,000	2,750	2,500
Lead	50	50	50	50	100	40	25	20
Mercury	0.8	0.8	0.8	0.8	0.8	0.3	0.1	0.1
Nickel	ND	ND	ND	ND	50	25	10	<10
Selenium	75	60	55	40	300	150	100	80
Silver	20	20	20	20	100	25	10	<10
Zinc	ND	ND	ND	ND	200	100	80	50

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*Detected, but not quantified with sufficient accuracy. Value is <10 micrograms/liter.
ND: Not detected.

(1) Data represent average values for two streams passing through parallel treatment systems at plant 0684F.
(2) Data represent average values for treatment system at plant 0868A.

TABLE X-5

JUSTIFICATION OF BAT EFFLUENT LIMITATIONS

	Type of Plant	Ammonia-N	Phenols (4 AAP)	Cyanide	Benzene	Naphthalene	Benzo(a)pyrene
BAT Effluent Limitations(1):							
30-Day Average	I&S	0.0160	0.0000319	0.00351	-	-	-
30-Day Average	Merc.	0.0177	0.0000355	0.00390	-	-	-
Daily Maximum	I&S	0.0543	0.0000638	0.00638	0.0000319	0.0000319	0.0000319
Daily Maximum	Merc.	0.0603	0.0000709	0.00709	0.0000355	0.0000355	0.0000355
Plant Data:							
A. Long Term - Plant 0868A	I&S	0.00364	0.00000974	0.00108	0.0000120	0.0000120	0.0000157
Plant 0012A	Merc.	0.0587	*	0.00436	NR	NR	NR
B. Plant Visits - Plant 0868A(003)	I&S	0.000645	0.000023	0.00196	<0.00005	ND	0.000011
Plant 0920F(008)	I&S	*	0.000033	0.00142	<0.00015	<0.000002	ND
Plant 0112(B)	I&S	*	0.000029	0.00170	NR	NR	NR
BAT Effluent Limitations(1) - Physical/Chemical Plants Only:							
30-Day Average	I&S	0.0322	0.0000430	-	-	-	-
30-Day Average	Merc.	0.0375	0.0000501	-	-	-	-
Daily Maximum	I&S	0.0645	0.0000859	-	0.0000215	0.0000215	0.0000215
Daily Maximum	Merc.	0.0751	0.000100	-	0.0000250	0.0000250	0.0000250
Plant Data:							
A. Long Term - Plant 0684F	I&S	*	0.0000784	-	NR	NR	NR
B. Plant Visits(2) - Plant 0684F(009)	I&S	*	*	-	<0.000004	<0.000002	<0.000001

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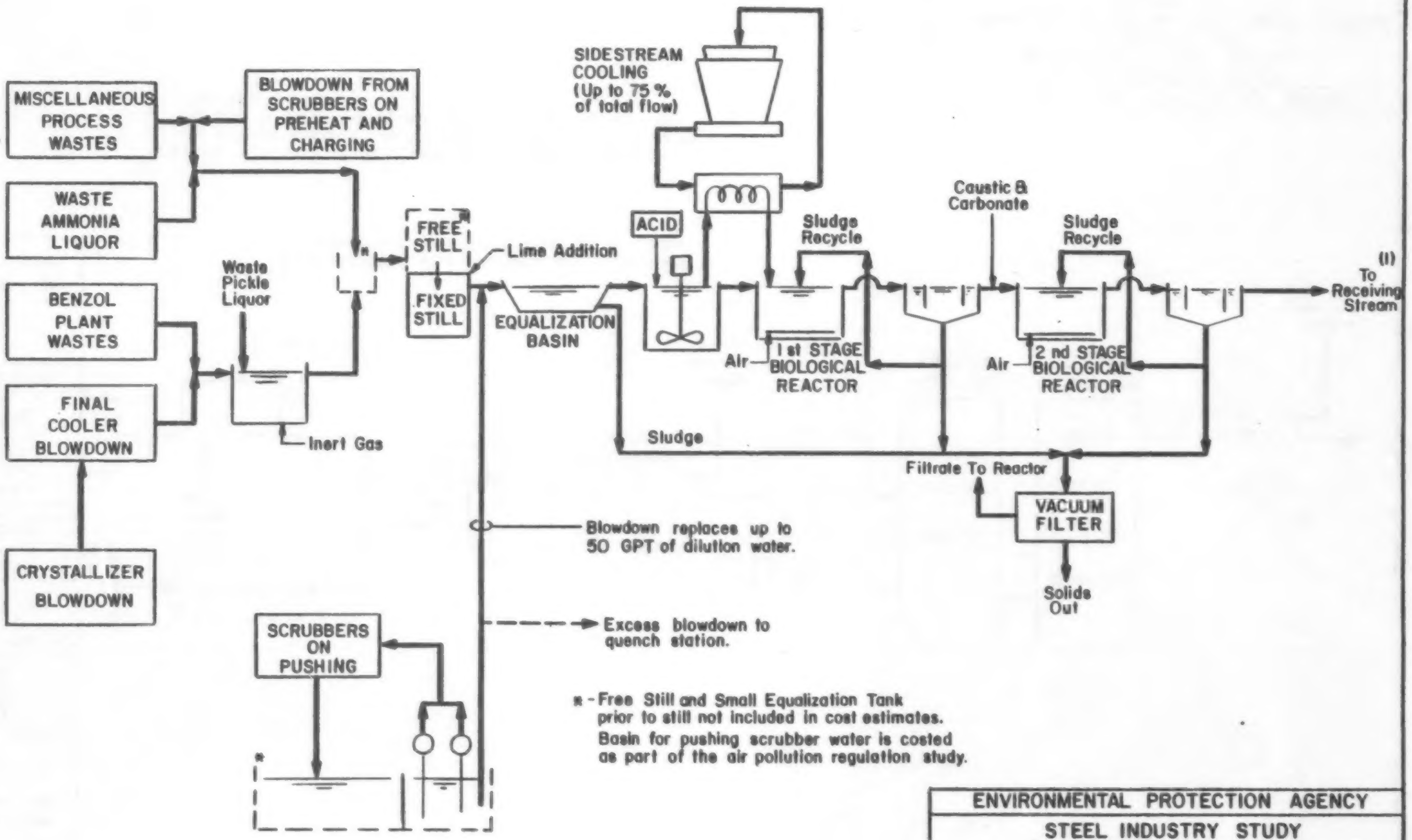
(1) Limitations are expressed in kg/kkg (lbs/1000 lbs) of coke produced.

(2) Plant 0732A was also visited, but the physical/chemical treatment system was under construction at that time. Data collected are not typical of current practice, nor of BAT level treatment.

I&S : Iron and Steel
Merc.: Merchant

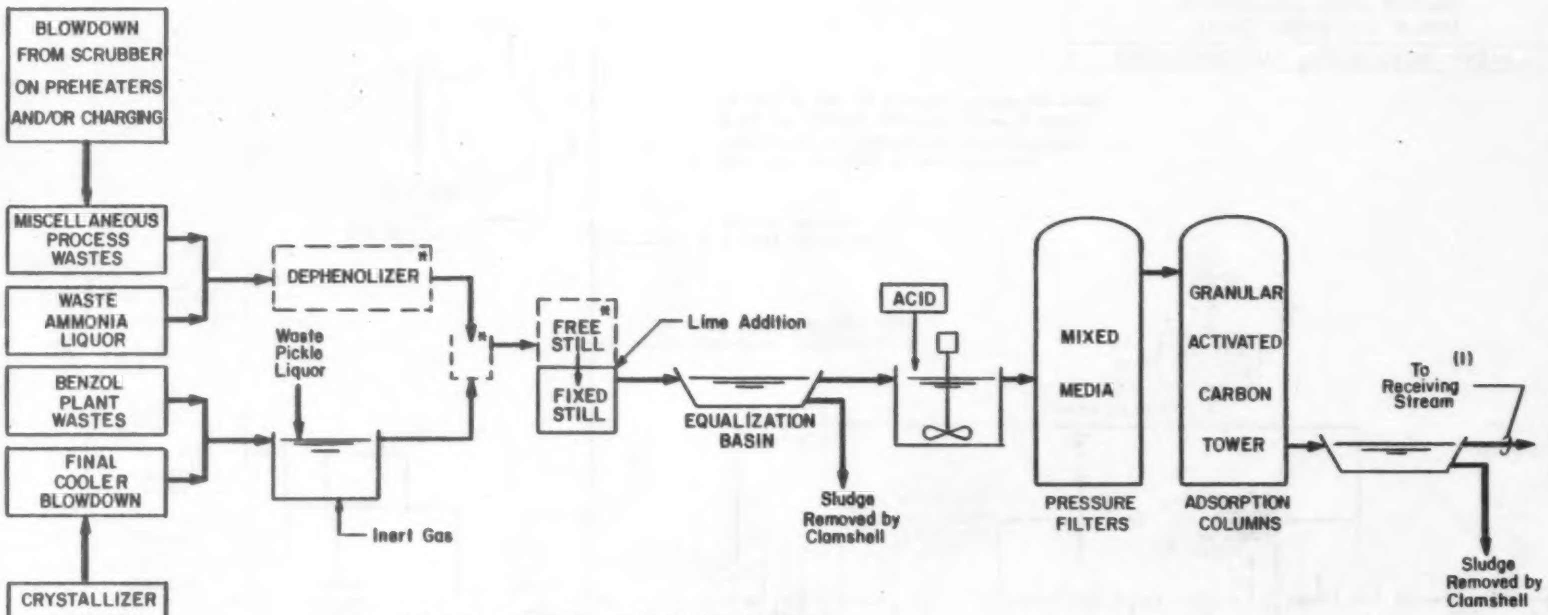
NR: Not reported by plant, or not analyzed for during plant visit.
ND: None detected.
* : Data does not support limitation.


MISCELLANEOUS PROCESS WASTES
BLOWDOWN FROM SCRUBBERS ON PREHEAT AND CHARGING
WASTE AMMONIA LIQUOR
BENZOL PLANT WASTES
FINAL COOLER BLOWDOWN
CRYSTALLIZER BLOWDOWN
Waste Pickle Liquor
Inert Gas
FREE STILL
FIXED STILL
Lime Addition
EQUALIZATION BASIN
SIDESTREAM COOLING (Up to 75 % of total flow)
ACID
Sludge Recycle
Air
1 st STAGE BIOLOGICAL REACTOR
Caustic & Carbonate
Sludge Recycle
Air
2 nd STAGE BIOLOGICAL REACTOR
(1) To Receiving Stream
Sludge
Filtrate To Reactor
VACUUM FILTER
Solids Out
Blowdown replaces up to 50 GPT of dilution water.
Excess blowdown to quench station.
SCRUBBERS ON PUSHING
*

* - Free Still and Small Equalization Tank prior to still not included in cost estimates. Basin for pushing scrubber water is costed as part of the air pollution regulation study.

(1) Refer to Table X-3 Alternative No. 1, for effluent loads. Flows are based on 638 l/kkg (153 gal./ton) for Iron & Steel Plants, and 709 l/kkg (170 gal./ton) for Merchant Plants.

ENVIRONMENTAL PROTECTION AGENCY			
STEEL INDUSTRY STUDY BY-PRODUCT COKE MAKING SUBCATEGORY BIOLOGICAL TREATMENT SYSTEM BAT MODEL			
Dwn. 12/22/81			FIGURE X-1


BLOWDOWN FROM SCRUBBER ON PREHEATERS AND/OR CHARGING
MISCELLANEOUS PROCESS WASTES
WASTE AMMONIA LIQUOR
BENZOL PLANT WASTES
FINAL COOLER BLOWDOWN
CRYSTALLIZER BLOWDOWN
DEPHENOLIZER *
Waste Pickle Liquor
Inert Gas
*
FREE STILL *
FIXED STILL
Lime Addition
EQUALIZATION BASIN
Sludge Removed by Clamshell
ACID
MIXED MEDIA
PRESSURE FILTERS
GRANULAR ACTIVATED CARBON TOWER
ADSORPTION COLUMNS
To Receiving Stream (1)
Sludge Removed by Clamshell

* - Dephenolizer, Free Still and Small Equalization Tank prior to still not included in cost estimates.

(1) Refer to Table X-3 Alternative No. 1 (Physical Chemical), for effluent loads. Flows are based on 430 l/kkg (103 gal./ton) for Iron & Steel Plants, and 500 l/kkg (120 gal./ton) for Merchant Plants.

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BY-PRODUCT COKE MAKING
SUBCATEGORY
PHYSICAL-CHEMICAL TREATMENT SYSTEM
BAT MODEL

Dwn. 12/22/81

FIGURE X - 2

COKEMAKING SUBCATEGORY

SECTION XI

BEST CONVENTIONAL POLLUTANT CONTROL TECHNOLOGY (BCT)

The 1977 Amendments added Section 301(b)(2)(E) to the Act establishing "best conventional pollutant control technology" (BCT) for discharges of conventional pollutants from existing industrial point sources. Conventional pollutants are those defined in Section 304(a)(4) [biochemical oxygen demanding pollutants (BOD_5), total suspended solids (TSS), fecal coliform, and pH], and any additional pollutants defined by the Administrator as "conventional" (oil and grease, 44 FR 44501, July 30, 1979).

BCT is not an additional limitation but replaces BAT for the control of conventional pollutants. In addition to other factors specified in Section 304(b)(4)(B), the Act requires that BCT limitations be assessed in light of a two part "cost-reasonableness" test. American Paper Institute v. EPA, 660 F.2d 954 (4th Cir. 1981). The first test compares the cost for private industry to reduce its conventional pollutants with the costs to publicly owned treatment works for similar levels of reduction in their discharge of these pollutants. The second test examines the cost-effectiveness of additional industrial treatment beyond BPT. EPA must find that limitations are "reasonable" under both tests before establishing them as BCT. In no case may BCT be less stringent than BPT.

EPA published its methodology for carrying out the BCT analysis on August 29, 1979 (44 FR 50732). In the case mentioned above, the Court of Appeals ordered EPA to correct data errors underlying EPA's calculation of the first test, and to apply the second cost test. (EPA had argued that a second cost test was not required.)

The Agency has decided to set the BCT limitations equal to the BPT limitations for cokemaking operations.

COKEMAKING SUBCATEGORY

SECTION XII

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF NEW SOURCE PERFORMANCE STANDARDS (NSPS)

Introduction

The new source performance standards (NSPS) are to specify the degree of effluent reduction achievable through the application of the best available demonstrated control technology processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge of pollutants. While this latter goal is achievable for beehive cokemaking operations, the Agency has decided not to propose NSPS for beehive operations because it is very unlikely that new beehive processes will be built in the future. However, even if some new source were to be built the BPT and BAT limitations (no discharge of wastewater pollutant to navigable streams) would apply to such sources.

For by-product cokemaking, a "no discharge of pollutants" standard is difficult to attain. The coking operation liberates moisture contained in the coal and, in effect, generates water as a by-product. Other sources of coke plant wastewaters are final cooler wastewaters, benzol plant wastewaters, coke quenching tower overflows, coke wharf drains, steam condensed in the ammonia stills, cooling tower and boiler blowdowns, cooling system leaks, general washwater used in the coke plant area, and dilution water, if any, used to optimize conditions for biological treatment. In addition, the latest in air pollution emission controls are required at new sources, which may increase the volumes of water requiring control and treatment.

If no liquid discharge is to be achieved from modern by-product coke plants, a means of total disposal must be found for the 135 liters/kkg (32 gal/ton) of excess flushing liquor which is produced. All of the pollutants in this water, with the possible exception of suspended solids, are amenable to pyrolytic decomposition. A rough estimate shows that about 126,000 kilogram calories per metric ton of coke produced would be required to dispose of this waste. This is a negligible percentage of the fuel value of the tar and gas generated in the production of a ton of coke. However, there is reason to believe that unless very sophisticated means are used to pyrolytically dispose of this water, serious air pollution problems would result. The gases released from less than optimum incineration of this water could be expected to contain high concentrations of the oxides of nitrogen and sulfur and some particulate matter. If a simple incinerator with a wet scrubber were used, the basic pollutants would merely be transferred back to another water stream, thus producing an even larger volume than the original.

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Since many of the toxic pollutants in the liquid stream are volatile, evaporation of the liquid to dryness would result in many of the same problems as incineration. In fact, examination of numerous other points of disposal of this stream within an integrated steel mill all yield the same answer. While total pyrolytic decomposition of this small wastewater stream to innocuous gases would be the most desirable method of complete disposal, air pollution impacts and energy constraints render this option impractical.

For the above reasons, the Agency decided not to propose "zero discharge" NSPS for by-product cokemaking.

Identification of NSPS Alternative Treatment Systems

Three NSPS alternative treatment systems were considered for new sources. Each has biological treatment as the principal component, while one includes powdered activated carbon addition for improved treatment. The biological sequence is demonstrated at Plant 0868A - the Agency's selection as the best treatment plant. Enhancement using powdered activated carbon (PAC) is currently undergoing testing at several operations. The operators of two coke plants with biological treatment systems are investigating the addition of PAC to the aeration basin to enhance removal of carbonaceous material and ammonia-N. Figure VIII-2 presents the model NSPS treatment systems and Table XII-1 present the model plant effluent quality data for the NSPS alternatives described below.

NSPS Alternative 1

At new cokemaking operations, the opportunity to minimize process wastewater flow is available. Hence, the first step in each NSPS alternative is the elimination of extraneous water. Dry desulfurizers are generally available and are recommended for use at new plants; however, the Agency has included allowances for wet desulfurizers. Operation of certain by-products recovery units may not be part of a new source plant. For example, companies may choose not to refine light oils (less benzol plant wastewater), or not to recover ammonia as an ammonium salt (replaces crystallizer wastewaters with a small volume waste). Even if ammonium sulfate is produced, vacuum crystallizers with steam ejectors should be equipped with surface condensers, rather than barometric condensers, or an alternate crystallization system can be used. For those plants where barometric condensers are to be installed, the wastewaters can be recycled with only very limited blowdowns requiring treatment. This latter step is considered to be a pollution control cost, while most of the other means to eliminate water are process related.

Modern and more efficient free and fixed ammonia stills are now available from several sources to provide effective ammonia recovery and cyanide stripping.

All wastewaters are transferred to a holding and equalization basin for detention; pH is adjusted; the wastewaters are then transferred to a two-step or extended biological oxidation system with a clarifier and vacuum filtration of underflows. Either dilution water or the addition of wastewaters from air pollution emission controls, up to 50 gal/ton, is included. Refer to Figure VIII-2 for a process flow diagram and Table VIII-9 for model plant costs.

NSPS Alternative 2

The alternative described above is supplemented with post filtration of the clarifier effluent to prevent pass through of toxic organic pollutants during treatment plant upsets.

NSPS Alternative 3

All parts of NSPS Alternative No. 2 are included with provisions for adding powdered carbon to both activated sludge basins. The filtration system prevents carryout of excessive suspended solids. Refer to Figure VIII-2 for a diagram of this alternative and Table VIII-9 for model plant costs.

NSPS Model Treatment System Flow Rates

Since charging, pushing and preheating emissions controls are generally required at new sources, all NSPS flows include up to 50 gal/ton from these sources in place of dilution water for the biological teratment systems. The recycle of barometric condenser wastewaters with a 3 gallon per ton blowdown is included in all alternatives, as are recycle of final cooler wastewaters and minimization of flows from benzol plants and miscellaneous sources. The model treated wastewater flow rates for each alternative are based upon 153 gallons/ton of coke for iron and steel coke plants and 170 gal/ton for merchant coke plants, which are the same model flows used as the bases for the BAT limitations. Refer to the discussion in Section X, and in particular to Table X-1 for further details on the NSPS model flow. The NSPS model treatment system flow rates are well demonstrated.

Response to Court Remand of NSPS model Flow

The previous NSPS were remanded by Third Circuit Court on the basis that the model flow was "not demonstrated." The only plant in the original survey with a treated effluent flow less than 100 GPT was plant C, and an undetermined portion of its process wastewaters was then disposed of by coke quenching.

The toxic pollutant survey turned Reference is made to Table III-3 for industry-wide data. Data submitted by 59 coke plants indicate that 12 have total process wastewater flow rates lower than 100 gal/ton. Thus, from plant data, it is evident that the 100 gal/ton flow is demonstrated by many plants using various disposal means. Two of the sampled plants (002 and 0684F) also had measured flows of less than 100 gal/ton.

Although the 100 gal/ton flow has been effectively demonstrated, cost estimates for NSPS and the standards are based upon 153 gal/ton for iron and steel plants and 170 gal/ton for merchant plants as the Agency believes these flows are more appropriate. The increase in flow compensates for the growing trend toward air pollution emissions control with wet scrubbers.

NSPS

The effluent standards for new sources are summarized in Table XII-2. Alternative No. 1 has been selected as the NSPS model treatment system (depicted in Figure XII-1). Refer to sections IX and X for a discussion of individual pollutants and the ability of existing plants to demonstrate compliance with NSPS. Table XII-3 compares NSPS with existing plant performance.

TABLE XII-1

EFFLUENT QUALITY FOR NSPS MODEL TREATMENT SYSTEMS COKEMAKING SUBCATEGORY

	Alternative:	1	2	3
Flow, gal/ton	Iron & Steel Merchant	153 170	153 170	153 170
TSS, mg/l		140	20	20
Oil & Grease*, mg/l		10	8	5
Ammonia-N, mg/l		25	25	20
Cyanides, mg/l		5.5	5.0	5.0
Phenols (4AAP), mg/l		0.05	0.05	0.03
Benzene*, mg/l		0.05	0.05	0.03
Naphthalene*, mg/l		0.05	0.05	0.03
Benzo(a)pyrene*, mg/l		0.05	0.05	0.03
pH (Units)		6 - 9	6 - 9	6 - 9

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*Values shown are maximum daily concentrations only.

TABLE XII-2

NEW SOURCE PERFORMANCE STANDARDS
COKEMAKING SUBCATEGORY

		NSPS Standards in kg/kkg (lbs/1000 lbs)(1)								
		TSS	O & G(2)	NH_3-N	Cyanides	Phenols (4AAP)	Benzene(2)	Naphthalene(2)	Benzo(a)pyrene(2)	pH Units
A. By-Product Cokemaking										
1. Alternative 1*										
Basic Standards(3)(4)	I&S	0.0894	0.00638	0.0160	0.00351	0.0000319	0.0000319	0.0000319	0.0000319	6-9
	Merchant	0.0993	0.00709	0.0177	0.00390	0.0000355	0.0000355	0.0000355	0.0000355	6-9
2. Alternative 2										
Basic Standards(3)(4)	I&S	0.0894	0.00638	0.0160	0.00319	0.0000319	0.0000319	0.0000319	0.0000319	6-9
	Merchant	0.0993	0.00709	0.0177	0.00355	0.0000355	0.0000355	0.0000355	0.0000355	6-9
3. Alternative 3										
Basic Standards(3)(4)	I&S	0.0128	0.00319	0.0128	0.00319	0.0000160	0.0000191	0.0000191	0.0000191	6-9
	Merchant	0.0142	0.00355	0.0142	0.00355	0.0000177	0.0000213	0.0000213	0.0000213	6-9
B. Beehive Cokemaking	No Discharge of Process Wastewater Pollutants to Navigable Streams									

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(1) 30-day average NSPS. Daily maximum values are 1.82 times the standards stated for cyanides, 1.93 times for TSS, 2.00 times for phenols (4AAP), and 3.4 times the standard stated for NH_3-N.

(2) For Oils and Greases, no monthly average is set. Values shown are daily maximum.

(3) Increased loadings, not to exceed 16 percent of the above standards for iron & steel plants, and 15 percent of the above standards for merchant plants are allowed for by-product coke plants which have wet desulfurization systems, but only to the extent that such systems generate an increased effluent volume.

(4) Increased loadings, not to exceed 39 percent of the above standards for iron & steel plants and 35 percent of the above standards for merchant plants are allowed for by-product coke plants which have indirect ammonia recovery systems, but only to the extent that such systems generate an increased effluent volume.

*: Selected NSPS alternative.

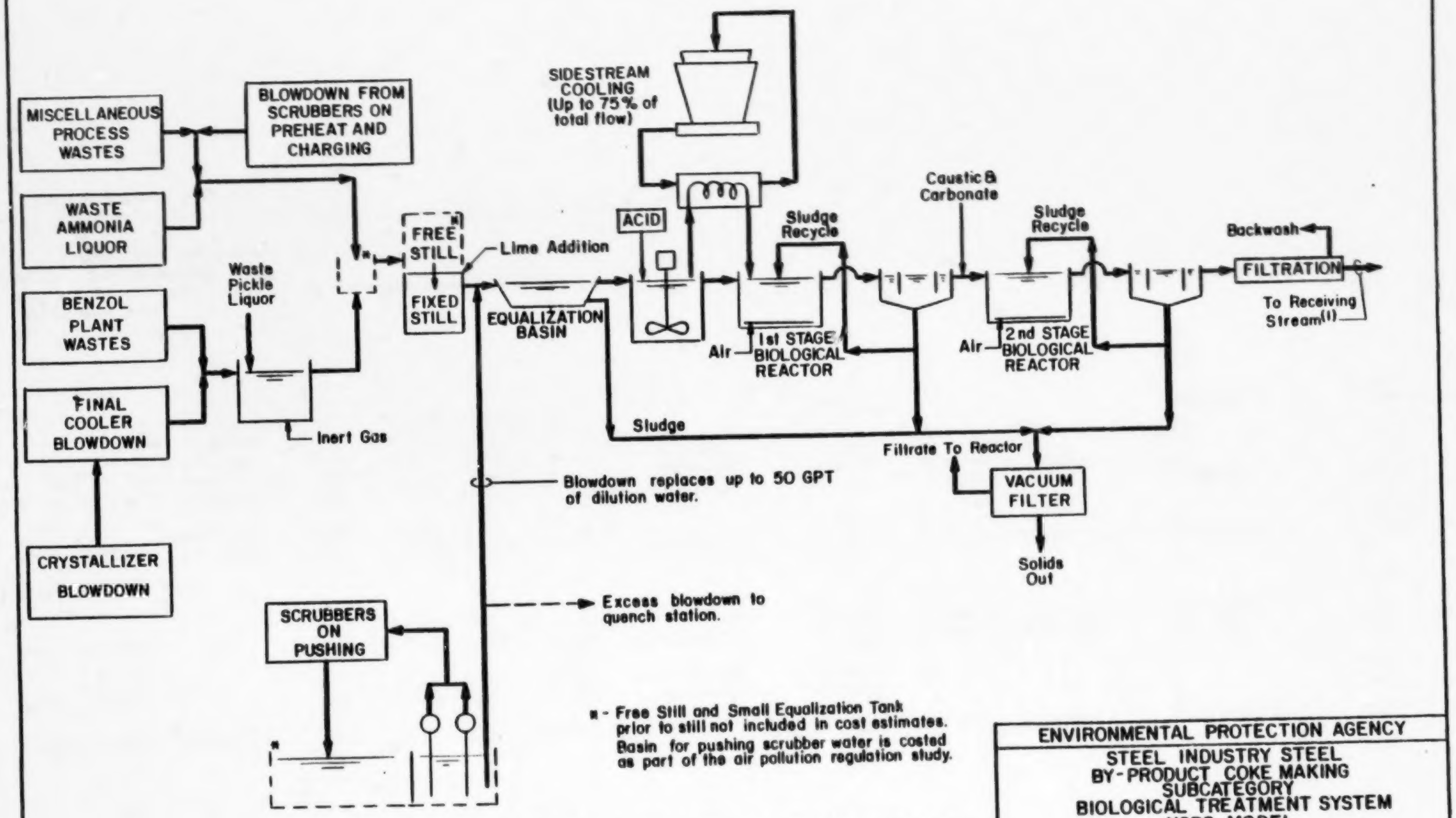
TABLE XII-3

JUSTIFICATION OF NSPS FOR BY-PRODUCT COKEMAKING

NSPS Effluent Standards[1]	Type of Plant	TSS	O&G[2]	Ammonia-N	Phenols (4AAP)	Cyanides	Benzene[2]	Napthalene[2]	Benzo(a)pyrene[2]	pH
30-Day Average	I&S	0.0894	-	0.0160	0.0000319	0.00351	-	-	-	6-9
	Merc.	0.0993	-	0.0177	0.0000355	0.00390	-	-	-	6-9
Daily Maximum	I&S	0.172	0.00638	0.0543	0.0000638	0.00638	0.0000319	0.0000319	0.0000319	6-9
	Merc.	0.192	0.00709	0.0603	0.0000709	0.00709	0.0000355	0.0000355	0.0000355	6-9
Plant Data:										
A. Long Term - Plant 0868A	I&S	0.0566	0.00384	0.00364	0.00000974	0.00108	0.0000120	0.0000120	0.0000157	6.1-8.2
Plant 0012A	Merc.	0.0992	*	0.0587	*	0.00436	NR	NR	NR	6.3-9.1
B. Plant - Plant 0868A(003)	I&S	0.0327	0.00355	0.000645	0.000023	0.00196	<0.00005	ND	0.000011	7.4-7.5
Visits Plant 0920F(008)	I&S	0.0249	0.00464	*	0.000033	0.00142	<0.000015	<0.000002	ND	7.5-7.8
Plant 0112(B)	I&S	0.0734	0.00113	*	0.000029	0.00170	NR	NR	NR	7.5
Plant 0272 (D)	Merc.	0.0645	0.00149	0.0137	*	*	NR	NR	NR	*
Plant 0464C(002)	Merc.	0.0009	0.00599	*	*	0.00243	*	*	0.000002	8.9-9.0

I&S : Iron and Steel
Merc.: Merchant
NR : Not reported by plant, or not analyzed during plant visit.
ND : None detected
* : Data does not support NSPS.

(1) Standards are expressed in kg/kkg (lbs/1000 lbs) of coke produced.
(2) Daily maximum standards only.


MISCELLANEOUS PROCESS WASTES
BLOWDOWN FROM SCRUBBERS ON PREHEAT AND CHARGING
WASTE AMMONIA LIQUOR
BENZOL PLANT WASTES
FINAL COOLER BLOWDOWN
CRYSTALLIZER BLOWDOWN
Waste Pickle Liquor
Inert Gas
FREE STILL *
FIXED STILL
Lime Addition
EQUALIZATION BASIN
SIDESTREAM COOLING (Up to 75% of total flow)
ACID
Sludge Recycle
Air
1st STAGE BIOLOGICAL REACTOR
Caustic & Carbonate
Sludge Recycle
Air
2nd STAGE BIOLOGICAL REACTOR
Backwash
FILTRATION
To Receiving Stream(1)
Sludge
Filtrate To Reactor
VACUUM FILTER
Solids Out
Blowdown replaces up to 50 GPT of dilution water.
Excess blowdown to quench station.
SCRUBBERS ON PUSHING
*

* - Free Still and Small Equalization Tank prior to still not included in cost estimates. Basin for pushing scrubber water is costed as part of the air pollution regulation study.

(1) Refer to Table XII-1 Alternative No. 1, for effluent loads. Flows are based on 638 l/kkg (153 gal./ton) for Iron & Steel Plants, and 709 l/kkg (170 gal./ton) for Merchant Plants.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STEEL
BY-PRODUCT COKE MAKING
SUBCATEGORY
BIOLOGICAL TREATMENT SYSTEM
NSPS MODEL

Dwn. 12/22/81

FIGURE XII-1

COKEMAKING SUBCATEGORY

SECTION XIII

PRETREATMENT STANDARDS FOR BY-PRODUCT COKE PLANTS DISCHARGING TO POTWS

Introduction

This section presents available pretreatment alternatives for coke plants with discharges to publicly owned treatment works (POTWs). The Agency has not promulgated pretreatment standards for beehive cokemaking operations. None of the existing beehive operations discharge to POTWs and it is unlikely that this would occur because of their location and the fact that existing beehive operations achieve zero discharge. Even if it could be determined that an existing beehive operator was proposing to discharge indirectly by a POTW, it would be extremely costly to pay sewerage charges for a wastewater which can effectively be eliminated using the BPT model treatment system. Moreover, the General Pretreatment Regulations, 40 CFR Part 403, applicable to all sources, including beehive cokemaking operations, would apply. Accordingly, the Agency has decided not to proposed pretreatment standards for beehive cokemaking plants.

The Agency has considerated pretreatment standards for new and existing by-product cokemaking operations. The general pretreatment and categorical pretreatment standards applying to cokemaking operations are discussed below.

General Pretreatment Standards

For detailed information on Pretreatment Standards refer to 46 FR 9404 et seq, "General Pretreatment Regulations for Existing and New Sources of Pollution," (January 28, 1981). See also 47 FR 4518 (February 1, 1982). In particular, 40 CFR Part 403 describes national standards (prohibited discharges and categorical standards), revision of categorical standards, and POTW pretreatment programs.

In establishing pretreatment standards for by-product cokemaking operations, the Agency considered the objectives and requirements of the General Pretreatment Regulations. The Agency determined that untreated discharges of cokemaking wastewaters to POTWs would result in pass through of toxic and nonconventional pollutants. The Agency also considered other factors specifically applicable to by-product cokemaking operations which are discussed below.

Pretreatment Alternatives for Cokemaking Operations

Because direct discharge limitations for cokemaking operations are based upon biological treatment, the Agency considered six alternative treatment systems for PSES ranging from a system similar to that provided by the industry prior to on-site biological treatment to full BAT treatment. These alternatives are illustrated in Figures VIII-1 and VIII-2 with accompanying effluent quality data presented in Table XIII-1. Model plant costs are presented in Table VIII-10.

PSES/PSNS Alternative 1

This alternative is similar to the level of pretreatment provided by the industry for cokemaking wastewaters prior to on-site biological treatment. Final cooler and barometric condenser wastewaters are recycled. Benzol plant wastewaters and final cooler blowdowns are routed through a dissolved gas flotation system for oil and scum removal. Waste ammonia liquors are dephenolized, and all wastewaters are stripped of ammonia-N with free and fixed ammonia stills. Equalization and pH control complete the pretreatment system.

PSES/PSNS Alternative 2

This alternative is the same as the model BPT treatment system described in Section IX and includes single stage biological treatment. The first step is the minimization of process wastewater flows by recycle of final cooler and barometric condenser wastewaters. Following recovery of by-products by free ammonia stripping and dephenolization, treatment continues with lime addition, fixed ammonia stripping, equalization and detention in a settling basin, and single stage biological oxidation prior to release to sanitary sewers.

PSES/PSNS Alternative 3

This alternative is the same as BAT-1, and includes all of PSES Alternative 2 plus a second stage biological oxidation unit to further reduce ammonia-N cyanide, phenols (4AAP) and, toxic organic pollutants.

PSES/PSNS Alternative 4

This alternative includes post filtration of the discharge of Alternative 3 described above.

PSES/PSNS Alternative 5

Alternative 5 includes the addition of powdered carbon to the above system. This alternative may produce slightly lower levels of suspended solids, oil and grease, toxic metals, and toxic organic pollutants.

PSES/PSNS Alternative 6

The treated effluent from Alternative 2 through 5 above may be disposed of by coke quenching where the impacts on air pollution can be tolerated. This alternative is not recommended even though it provides a means of achieving zero discharge.

Pretreatment Considerations for Cokemaking Operations

Ammonia-N

Most POTWs in the United States are not designed for nitrification. Hence, aside from incidental removal, most if not all of the ammonia-N introduced into POTWs from cokemaking operations will pass through into receiving waters without treatment. Depending on the size of the POTW and the volume of and pretreatment provided for cokemaking wastewaters, operating problems may not be experienced at the POTW because of dilution. nonetheless, the ammonia-N discharged to the POTW will pass through untreated.

The discharge from Plant 0584B to the Detroit sewerage system provides an excellent example of the above. Waste ammonia liquors from the coke plants at Plant 0584B are pretreated with free ammonia stills and dephenolizers prior to discharge to the Detroit sewerage system along with sanitary wastewaters and minor miscellaneous coke plant sources. Final cooler wastewaters, benzol plant wastewaters, and pushing emission control wastewaters are disposed of by coke quenching at this plant. The ammonia-N discharge from Plant 0584B to the Detroit sewage treatment plant ranges between 12,000 and 15,000 lbs/day. Since the Detroit sewage treatment plant is designed to provide secondary treatment (no ammonia-N removal) for 800 MGD, the coke plant wastewater is diluted and does not interfere with POTW operations. Hence, virtually the total coke plant ammonia-n discharge continues to reach the Detroit River.

Another example of lack of POTW treatment for ammonia-N resulting from cokemaking operations is provided by the East Chicago, Indiana sewage treatment plant. This facility receives partially treated coke plant wastewaters from Plants 0384A and 0948C. Recent investigations of this facility by Region V of EPA show the plant is experiencing significant operating problems, notably with respect to sludge handling and overall efficiency. The Region attributes many of the problems at this facility to coke plant wastewaters. Data for the East Chicago sewage treatment plant demonstrate this facility does not remove or otherwise treat ammonia-N. Hence, the ammonia-N discharges from Plants 0384A and 0948C pass through untreated.

Data for the Middletown, Ohio sewage treatment plant, which is a well-run secondary treatment facility, show that partial nitrification is occurring at the plant. It is likely that this plant will be upgraded to full nitrification in the future. In this case the ammonia-n discharged from Plant 0060 into the Middletown sewage treatment plant would not pass through the municipal facility.

Total Cyanide

As noted in Volume I, Section V, cyanide compounds can interfere with the operation of and pass through POTWs, as well as enhance the toxicity of metals commonly found in POTW effluents. The Agency's data indicate that pass through of cyanide at municipal sewage treatment plants is about 50%. Available data for the Middletown, Ohio sewage treatment plant demonstrate pass through of cyanide from Plant 0060.

Phenolic Compounds

Phenol and phenolic compounds can be effectively treated in POTWs with properly acclimated systems. Data for the Middletown, Ohio sewage treatment plant show consistent effluent concentrations in the low parts per billion range.

Toxic Organic Pollutants

Raw and partially treated cokemaking wastewaters from several coke plants containing high concentrations of toxic organic pollutants are currently discharged to POTWs. Based upon the information and data presented in Volume I, data from the Middletown, Ohio sewage treatment plant, and data for coke plant biological treatment plants, the Agency concludes that the toxic organic pollutants found in cokemaking wastewaters can be significantly reduced with properly designed and operated biological treatment systems. However, many of these pollutants are degraded to only a limited extent in POTWs and most tend to concentrate in POTW sludges.

Selection of Pretreatment Alternatives

The promulgated pretreatment standards for existing sources (PSES) and new sources (PSNS) are based upon PSES/PSNS Alternative 1, (see Table XIII-2 and Figure XIII-1).. As noted above, this level of pretreatment is similar to that provided by the industry prior to on-site biological treatment of cokemaking wastewaters. As shown by the data presented below, the Agency believes this level of pretreatment will prevent pass through of coke plant pollutants at POTWs to a greater extent than would occur if untreated cokemaking wastewaters were discharged to POTWs:

	PSES/PSNS Alternative 1	POTW
Ammonia-N	94%	0%
Total Cyanide	80%	52%
Phenols (4AAP)	92%	-
Benzene	82%	-
Benzo(a)pyrene	73%	-
Naphthalene	89%	-

TABLE XIII-1

PRETREATMENT ALTERNATIVES
COKEMAKING SUBCATEGORY

Alternatives:		1	2	3	4	5	6
Flow, gal/ton	Iron & Steel	103	225	153	153	153	0
	Merchant	120	240	170	170	170	0
Ammonia-N, mg/l		75	97	25	25	20	-
Cyanides, mg/l		20	23	5.5	5.0	5.0	-
Phenols (4AAP), mg/l		50	1.6	0.05	0.05	0.025	-
Benzene*, mg/l		-	-	0.05	0.05	0.03	-
Naphthalene*, mg/l		-	-	0.05	0.05	0.03	-
Benzo(a)pyrene*, mg/l		-	-	0.05	0.05	0.03	-

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* Values shown are maximum daily concentrations only.

TABLE XIII-2

PRETREATMENT STANDARDS FOR EXISTING AND NEW SOURCES
COKEMAKING SUBCATEGORY

		Pretreatment Standards in kg/kkg (lbs/1000 lbs)(1)					
		NH3-N	Cyanides	Phenolic Compounds	Benzene(2)	Naphthalene(2)	Benzo(a)pyrene(2)
I. BY-PRODUCT COKEMAKING							
A. Alternative 1:*							
Basic Limitation	Iron & Steel	0.0322	0.00859	0.0215	-	-	-
	Merchant	0.0375	0.0100	0.0250	-	-	-
B. Alternative 2:							
Basic Limitation	Iron & Steel	0.0912	0.0219	0.00150	-	-	-
	Merchant	0.0973	0.0233	0.00160	-	-	-
C. Alternative 3:							
Basic Limitation	Iron & Steel	0.0160	0.00351	0.0000319	0.0000319	0.0000319	0.0000319
	Merchant	0.0177	0.00390	0.0000355	0.0000355	0.0000355	0.0000355
D. Alternative 4:							
Basic Limitation	Iron & Steel	0.0160	0.00319	0.0000319	0.0000319	0.0000319	0.0000319
	Merchant	0.0177	0.00355	0.0000355	0.0000355	0.0000355	0.0000355
E. Alternative 5:							
Basic Limitation	Iron & Steel	0.0128	0.00319	0.0000160	0.0000191	0.0000191	0.0000191
	Merchant	0.0142	0.00355	0.0000177	0.0000213	0.0000213	0.0000213
F. Alternative 6:							
Basic Limitation	Iron & Steel Merchant	No Discharge Of Process Wastewaters To POTW					
II. BEEHIVE COKEMAKING		No Discharge Of Process Wastewaters To POTW					

---

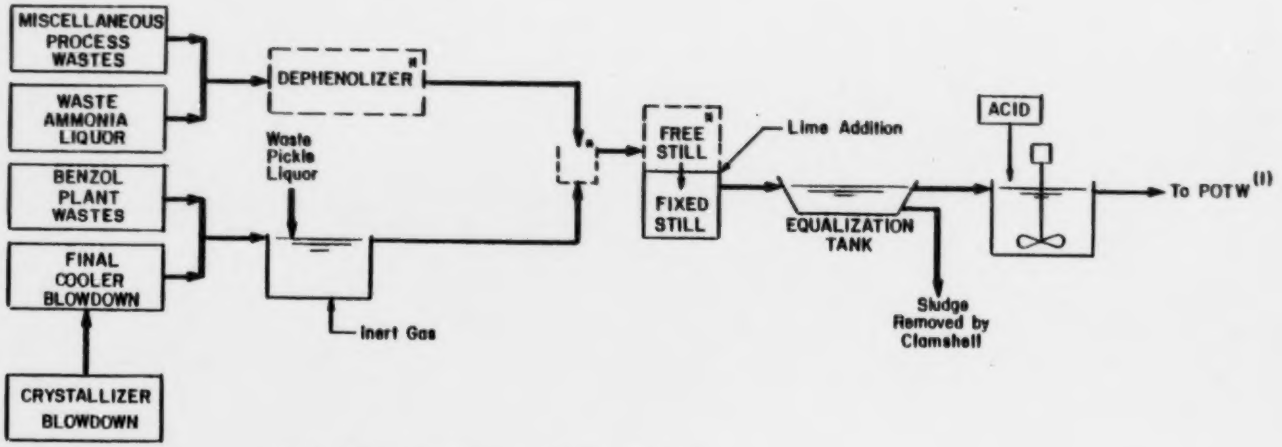
(1) 30-day average PSES. Daily maximum values are two times the standards stated for Alternatives 1 and 2 and all phenols (4AAP); 1.82 times the standards stated for cyanides; 3.4 times the stated value for NH_3N for all other alternatives.

(2) Daily maximum standards only.

(3) Increased loadings, not to exceed 24 percent of the above standards for iron & steel plants and 21 percent for merchant plants for Alternative 1, 11 percent for iron & steel and 10 percent for merchant plants for Alternative 2, and 16 percent for iron & steel plants and 15 percent for merchant plants for all other alternatives are allowed for by-product coke plants which have wet desulfurization systems, but only to the extent that such systems generate an increased discharge volume.

(4) Increased loadings, not to exceed 58 percent of the above standards for iron & steel plants and 50 percent for merchant plants for Alternative 1, 27 percent for Iron & Steel and 25 percent for merchant plants for Alternative 2, and 39 percent for iron & steel plants and 35 percent for merchant plants for all other alternatives are allowed by-product coke plants which have indirect ammonia recovery systems, but only to the extent that such systems generate an increased discharge volume.

* : Selected PSES and PSNS Alternative


MISCELLANEOUS PROCESS WASTES
WASTE AMMONIA LIQUOR
BENZOL PLANT WASTES
FINAL COOLER BLOWDOWN
CRYSTALLIZER BLOWDOWN
DEPHENOLIZER *
Waste Pickle Liquor
Inert Gas
*
FREE STILL *
FIXED STILL
Lime Addition
EQUALIZATION TANK
Sludge Removed by Clamshell
ACID
To POTW (1)

* - Dephenolizer, Free Still and small equalization tank prior to stills are not included in cost estimates.

(1) Refer to Table XIII - 1 Alternative No. 1, for effluent loads. Flows are based on 430 l/kkg (103 gal./ton) for Iron & Steel Plants, and 500 l/kkg (120 gal./ton) for Merchant Plants.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BY - PRODUCT
SUBCATEGORY
PSES MODEL

Dwn. 12/23/81

FIGURE XIII - 1

SINTERING SUBCATEGORY

SECTION I

PREFACE

The USEPA has promulgated effluent limitations and standards for the steel industry pursuant to Section 301, 304, 306, 307 and 501 of the Clean Water Act. The regulation contains effluent limitations for best practicable control technology currently available (BPT); best available technology economically achievable (BAT); pretreatment standards for new and existing sources (PSNS and PSES); and new source performance standards (NSPS). Effluent limitations for best conventional pollutant control technology (BCT) have been reserved for future consideration.

This part of the Development Document highlights the technical aspects of EPA's study of the Sintering Subcategory of the Iron and Steel Industry. Volume I of the Development Document addresses general issues pertaining to the industry while other volumes contain specific subcategory reports.

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SINTERING SUBCATEGORY

SECTION II

CONCLUSIONS

Based upon this study, a review of previous studies by EPA, and comments received on the proposed regulation (46 FR 1858), the Agency has reached the following conclusions concerning sintering operations:

1. The Agency has retained one subcategory for all sintering operations. The expanded data base confirms that further subdivision is not necessary to effectively regulate all sintering operations.

2. The data indicate that the BPT effluent limitations originally promulgated (1974) for sintering operations did not sufficiently account for wastewater discharges from all sintering wastewater sources. Accordingly, the Agency has promulgated less stringent BPT effluent limitations for suspended solids and oil and grease based upon a model plant effluent flow of 120 gal/ton. Compliance with the BPT limitations is demonstrated by systems treating both machine (windbox) and discharge end wastewaters.

3. The Agency's monitoring of sintering process wastewaters revealed significant concentrations of four toxic organic and six toxic metal pollutants, in addition to cyanide. The Agency concluded that the discharge of these pollutants can be controlled by available, economically achievable technologies. The Agency has, therefore, promulgated BAT limitations. A summary of raw waste loadings and the discharges resulting from attainment of the BPT and BAT limitations is presented below.

DIRECT DISCHARGERS
Pollutant Loadings (tons/year)

	Raw Waste	BPT	BAT
Flow (MGD)	93.4	7.2	7.2
Ammonia(N)	853.8	65.8	65.8
Cyanide(T)	28.5	2.2	2.2
Fluoride	853.8	274.1	219.3
Oil and Grease	34,153.3	76.8	38.4
Phenols(4AAP)	28.5	2.2	2.2
TSS	868,064.2	427.6	109.7
Total Toxic Metals	298.8	14.0	4.8
Total Toxic Organics*	17.1	1.3	1.3

* Toxic organics does not include the individual phenolic compounds.

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A summary of raw waste loadings and the discharges resulting from attainment of the PSES is presented below.

INDIRECT (POTW) DISCHARGERS
Pollutant Loadings (tons/year)

	Raw Waste	PSES
Flow(MGD)	5.8	0.5
Ammonia(N)	53.4	4.4
Cyanide(T)	1.8	0.1
Fluoride	53.4	14.6
Oil and Grease	2,134.6	2.6
Phenols(4AAP)	1.8	0.1
TSS	54,254.0	7.3
Total Toxic Metals	18.7	0.3
Total Toxic Organics*	1.1	0.1

* Toxic organics does not include the individual phenolic compounds.

4. The Agency's estimates of the costs of compliance with BPT, BAT and PSES for the sintering subcategory are presented below for facilities in place as of July 1, 1981. The Agency has determined the effluent reduction benefits associated with compliance with the effluent limitations and standards justify these costs.

Costs (Millions of July 1, 1978 Dollars)

	Investment Costs		Annual Costs	
	In-Place	Required	In-place	Required
BPT	58.8	5.1	19.8	2.2
BAT	0.5	5.5	0.05	0.8
PSES	3.2	0.4	1.3	0.05
TOTAL	62.5	11.0	21.1	3.0

The Agency has also determined that the effluent reduction benefits associated with compliance with new source standards (NSPS, PSNS) justify these costs.

5. The BPT, BAT, and PSES model treatment systems for the sintering subcategory include wastewater recycle. Responses from the industry regarding several sintering operations indicate that the recycle systems in use at these plants do not present significant problems with respect to scaling, fouling or plugging. The Agency has concluded that the use of recycle systems is a reasonable and demonstrated method of achieving the limitations and standards for this subcategory.

6. The Agency has not promulgated BCT limitations for conventional pollutants (TSS and oil and grease) in sintering wastewaters. This section of the regulation is reserved for future consideration.

7. NSPS for sintering operations using wet methods of air pollution control are the same as the BAT effluent limitations and are based upon the BPT and BAT wastewater treatment technologies. It is recognized that dry air cleaning systems which do not generate process wastewaters may be installed on new source sintering operations.

8. EPA has promulgated pretreatment standards for new and existing sources (PSNS and PSES) discharging to POTWs which limit the amount of toxic pollutants which can be introduced into a POTW. These standards are intended to minimize the impact of pollutants which pass through POTW operations.

9. Although four toxic organic and six toxic metal pollutants, in addition to cyanide, were found in the raw wastewaters from sintering operations, the Agency believes it is not necessary to directly limit each toxic pollutant. The Agency believes that adequate control of toxic metal pollutants can be achieved by the control of lead and zinc. Toxic organic pollutants are not limited for sintering operations.

10. To facilitate less costly central treatment and to make the sintering limitations compatible with the ironmaking limitations, the Agency has promulgated BAT limitations and NSPS, PSES and PSNS for ammonia-N, total cyanide, and phenols(4AAP) for sintering wastewaters which are co-treated with ironmaking wastewaters.

11. With regard to "remand issues," the Agency concludes that:

    a. Regarding the use of tight recycle systems for sintering operations, the discharge flow of 75 gal/ton for new sources has not been adequately demonstrated. Consequently, the Agency based NSPS, as well as the other effluent limitations and standards on a demonstrated flow of 120 gal/ton.

    b. The estimated cost to install a wastewater treatment system is not significantly affected by whether it is an "initial fit" or a "retrofit". In addition, the ability to implement various wastewater treatment practices is not affected by plant age. A comparison of actual costs (reported for the plants visited or represented by the industry D-DCP responses) with EPA's cost estimates developed from treatment models indicates that the estimated subcategory treatment costs are sufficiently generous to cover site-specific and other incidental costs.

c. The treatment technologies included in the various model treatment systems will not cause any significant impacts on the consumptive use of water.

12. Table II-1 presents the BPT effluent limitations and the supporting treatment model flow and effluent quality data for the sintering subcategory. Table II-2 presents the treatment model flow and effluent quality data, as well as the limitations and standards used to develop the BAT effluent limitations and the NSPS, PSES, and PSNS for the sintering subcategory.

13. The annual costs presented above are different than those used by the Agency in the Economic Impact Analysis completed for this regulation. After the Economic Impact Analysis was completed, the Agency discovered an error in the estimated sludge disposal costs for sintering operation. The correct costs are presented in this document. The incorrect annual cost used in the Economic Impact Analysis are about 8.2 million dollars less for treatment facilities in place, and 0.9 million dollars less for required treatment facilities. The Agency does not consider these differences significant in terms of whether the costs of achieving the resulting effluent reduction benefits are justified. In addition, with respect to possible economic impacts, differences of this magnitude were accounted for by the sensitivity analysis included in the Economic Impact Analysis.

TABLE II-1

BPT MODEL FLOW, MODEL EFFLUENT QUALITY, AND EFFLUENT LIMITATIONS
SINTERING SUBCATEGORY

Pollutant	Treatment Model Effluent Quality		Effluent Limitations (kg/kkg of Product)	
	Daily Maximum Concentration(1)	30-Day Average Concentration(1)	Daily Maximum Limitations	30-Day Average Limitations
Flow, gal/ton	120		NA	
pH, Units	6.0 to 9.0		6.0 to 9.0	
Oil and Grease	30	10	0.0150	0.00501
Total Suspended Solids	150	50	0.0751	0.0250

NA: Not applicable

(1) Concentrations are expressed in mg/l unless otherwise noted.

TABLE II-2

MODEL FLOW, MODEL EFFLUENT QUALITY, AND EFFLUENT LIMITATIONS AND STANDARDS

		Treatment Model Effluent Quality		BAT Effluent Limitations(2)		
	Pollutant	Daily Maximum Concentrations(1)	30-Day Average Concentrations(1)	Daily Maximum Limitations	30-Day Average Limitations	BCT Effluent Limitations
	Flow, gal/ton	120		NA		(3)
	pH, Units	6.0 to 9.0		NA	NA	
	Ammonia (N)*	30	10	0.0150	0.00501	
	Oil and Grease	10	NA	NA	NA	
	Phenols (4AAP)*	0.2	0.1	0.000100	0.0000501	
	Residual Chlorine*	0.5	NA	0.000250	NA	
	Total Suspended Solids	40	15	NA	NA	
121	Cyanide (T)*	2	1	0.00100	0.000501	
122	Lead	0.75	0.25	0.000375	0.000125	
128	Zinc	0.90	0.30	0.000450	0.000150	

		NSPS(2)		PSES(2)		PSNS(2)	
	Pollutant	Daily Maximum Standards	30-Day Average Standards	Daily Maximum Standards	30-Day Average Standards	Daily Average Standards	30-Day Average Standards
	Flow, gal/ton	NA		NA		NA	
	pH, Units	6.0 to 9.0		NA	NA	NA	NA
	Ammonia (N)	0.0150	0.00501	0.0150	0.00501	0.0150	0.00501
	Oil and Grease	0.00501	NA	NA	NA	NA	NA
	Phenols (4AAP)	0.000100	0.0000501	0.000100	0.0000501	0.000100	0.0000501
	Residual Chlorine	0.000250	NA	NA	NA	NA	NA
	Total Suspended Solids	0.0200	0.00751	NA	NA	NA	NA
121	Cyanide (T)	0.00100	0.000501	0.00100	0.000501	0.00100	0.000501
122	Lead	0.000375	0.000125	0.000375	0.000125	0.000375	0.000125
128	Zinc	0.000450	0.000150	0.000450	0.000150	0.000450	0.000150

NA: Not Applicable

* These limitations and standards shall be applicable only when sintering wastewaters are treated with ironmaking wastewaters.

(1) Concentrations are expressed in mg/l unless otherwise noted.

(2) Kg/Kkg of product.

(3) BCT is reserved.

SINTERING SUBCATEGORY

SECTION III

INTRODUCTION

Discussion

During iron and steel production operations, large quantities of particulate matter (fines, mill scale, flue dust) are generated by blast furnaces; open hearth, electric arc, and basic oxygen furnaces; and, hot forming mills. The particulate matter is removed from process gases by dry or wet air pollution control devices to reduce air emissions or to clean the gases for reuse as fuel. Mill scale is recovered from wastewaters discharged from hot forming operations. A large percentage of this iron rich material is recovered through the sintering operation. The fused material (sinter) produced by the sintering operation is reused as raw material in blast furnaces.

Description of the Sintering Process

Sintering is an agglomeration process in which iron bearing materials (generally fines) are mixed with iron ore, limestone, and finely divided fuel such as coke breeze. The fines consist primarily of mill scale and dust from basic oxygen furnaces, open hearth furnaces, electric arc furnaces, and blast furnaces. Mixers (e.g., ball drums) are used to mix the raw materials before they are placed on the traveling grate of the sinter machine. Near the head end of the grate, the surface of the raw materials is ignited by a gas fired ignition furnace located over the bed. As the mixture moves along on the traveling grate, air is drawn down through the mixture at the wind boxes to enhance combustion and to sinter (fuse) the fine particles. As the bed burns, carbon dioxide, cyanides, sulfur compounds, chlorides and fluorides are driven off with the gases. Oil and grease on the mill scale is vaporized and driven off.

The sinter drops off the grate at the discharge end of the machine and is cooled (either by air or a water spray), crushed, and screened. Screening is necessary to maintain uniformity in the size of the sinter fed to blast furnaces. Improperly sized sinter and the fines from the screening operation are returned to the operation for reprocessing. Wastewaters are generated in this process primarily as a result of scrubbing the gases and dusts associated with the sintering process. Wastewaters are also discharged if excess water is used to cool the sinter. The sintering operation wastewater sources are depicted in the process flow diagrams (Figures III-1, III-2 and III-3).

Eleven of the thirty-three (the confidential plant is not included in this total) sinter plants in the United States do not generate any process wastewaters since dry air pollution control equipment is used at these plants (refer to Table III-1). One plant has no air pollution control equipment and does not generate sintering process wastewaters. Dry air pollution control equipment includes cyclonic dust collectors or, with newer operations, fabric type dust filters. The "dry" plants are listed in Table III-1 but are excluded from further review since they do not generate process wastewaters.

Sinter production capacity ranges from 500 to 12,200 tons/day for "wet" plants and from 1,132 to 16,600 tons/day for "dry" plants (Table III-3). The total rated capacity of all plants (excluding the capacity of one plant which was claimed to be confidential) is 148,212 tons/day. "Wet" plants comprise about 57% of the total capacity.

The pollutants generated in sintering operations include suspended solids and oil and grease, as well as toxic inorganic and organic pollutants. The originally promulgated (1974) regulation for sintering operations included effluent limitations for total suspended solids, oil and grease, and pH.

Data Collection Activities

For this study, the Agency conducted additional sampling and gathered detailed information from the industry to provide an expanded data base to develop limitations. The primary sources of industry information are DCP (basic questionnaire) responses. The DCP requested information pertaining to production processes, process water usage, process wastewater discharges, and wastewater treatment systems. The Agency received DCP responses from every sintering operation. These data are presented in Table III-1.

Detailed questionnaires (D-DCPs) were sent to five plants. The D-DCPs sought long-term treatment facility effluent quality, operating cost, and sintering process operating data. The D-DCP responses assisted in verifying cost estimates, and establishing retrofit costs. Only two plants provided long-term analytical data relating to the previously limited BPT pollutants. No data were provided by the industry for toxic metal and toxic organic pollutants.

The Agency identified 34 steel plants with sintering operations. Confidentiality was claimed for one plant with regard to all data submitted. These data are not included in Table III-1. The Agency visited four plants during the original guidelines survey. The Agency determined that data for three of these plants were not suitable for use: one did not supply requested cost or production data; another operation treated sintering wastewaters in combination with wastewaters from another process, thereby making treatment predictions difficult; and, the third plant had problems with equipment during the sampling survey and the sintering wastewater could not be sampled. During the toxic pollutant survey, the Agency conducted another sampling visit at one of these plants and also visited two additional plants to increase the data base and to monitor for the presence of toxic pollutants. The results of these sampling visits (Plants 0060F, 0112D, and 0432A) demonstrate that significant quantities of toxic metal pollutants are found in sintering wastewaters. The Agency also conducted pilot scale wastewater treatment system demonstration studies at plant 0060. Table III-2 summarizes the data base for sintering operations.

As with the originally promulgated effluent limitations and NSPS, the limitations and standards are established on a unit process basis. Supporting this approach is the observation that all plants combine their various sintering process wastewaters for treatment. This system provides for the increased efficiencies of operation associated with the common treatment of various unit process wastewaters.

TABLE III-1

GENERAL SUMMARY TABLE
SINTERING

Plant Code	Air Pollution Equipment	Age-First Year of Prod.	Production-TPD Rated	Production-TPD 1976	Applied Flow (gal/ton)	Disch. Flow (gal/ton)	Treatment Compounds Process Treatment	Treatment Compounds Central Treatment	Operating Mode	Discharge Mode
0060	Wet & Dry	1975	2640	1875	[1667]	[219]		NW,SL Unk, FLL,FLP,FLO[1] CL,SS, (VF)	RTP-70 RUP-10 REU-7	Direct
0060B	Wet & Dry	1958	2400	1647	2186	2186		PSP,CL,FLP, VF	RET-100	
0060F	Wet & Dry	1957	1360	1078	[301]	[26]	NL,FLL,CL	FLP,CL,VF	RTP-91	Direct
0112	Dry Only	1930	6145							
0112A	Wet & Dry	1976	12,200	8260	[1604]	[288]		(FLP),FLL,NL, CL,VF	RTP-82	Direct
0112B	Wet & Dry	1950	4000	3779	133	133		T,CL,VF	OT	Direct
0112C	Wet & Dry	1948	2683	2412	1292	793		CL,T,VF,NL	RTP-39	Direct
0112D	Wet & Dry	1975	6070	5100	[1432]	[142]	NL	NL,NW,NA,FLP, CL,SS,T, SL Unk,VF	RTP-90	Direct
0384A	Dry Only	1959		4000						
0396A	Wet & Dry	1959	3312	2642	[341]	[85]		VF,FLP,CL,CT, (NA)	RTP-75	POTW
0432A	Wet & Dry	1960	6500	5856	[245]	[245]		SCR,PSP,FLP, T,CLA,VF	OT	Direct
0432C	Dry Only	1957	2500							
0448A	Wet & Dry	1943	3850	2325	Unk	0	SL(Unk) for sludge, (FLP), (NA)		RTP-100	
0492A	Wet & Dry	1947	1900	1072	2582	2582		SL(Unk), (FLP),(VF), (RTP),(NA)	RET-100	Direct
0584B	Dry Only	1958	4600							
0584C	Wet & Dry	1959	3800	2486	1368	1368		SS,SL(Unk), FDSP,CLB,(FLP), (RTP),(NA)	OT	Direct

TABLE III-1
GENERAL SUMMARY TABLE
SINTERING
PAGE 2

Plant Code	Air Pollution Equipment	Age-First Year of Prod.	Production-TPD Rated	Production-TPD 1976	Applied Flow gal/ton	Disch. Flow gal/ton	Treatment Compounds Process Treatment	Treatment Compounds Central Treatment	Operating Mode	Discharge Mode
0584F	Wet & Dry	1955	8187	4750	106	106	CL,VF,	T,FLP,VF, (NA)	OT	Direct
0684B	Dry Only	1943	Unk							
0684I	Dry Only	1961	1500							
0856F	Wet & Dry	1956	7200	6711	[220]	[220]	T,(FLP), (VF),(RTP),(NA)		OT	Direct
0856J	Dry Only	1959	15,000							
0856N	NONE	1948	1132							
0856Q	Wet & Dry	1949	500	616	2805	117	PSP,T	T,VF	RTP-96 RET-4	ES
0856T	Dry Only	1960	5000							
0860B**	Dry Only	1950-58	16,600							
0860H	Dry Only	1958	5000							
0864A	Wet & Dry	1944	2910	1373	[2819]	[1733]	FLL,FLP,CL, SL(Unk),(VF) (RTP),(NA)		RET-45 RTP-38	Direct
0868A	Dry Only*	1941	7783	6306	100	70	SL(Unk)		RTP-30	Direct & Quench
0920B	Wet & Dry	1966	1000	860	134	134		FLP,T,CL, FDC(Unk),VF, (NA)	OT	Direct
0920F	Wet & Dry	1944	1500	1130	[2124]	[74]	NC,CL, (FLP),(VF)		RTP-4 RUP-90 RET-3	Direct
0946A	Wet Only	939	540	218	6605	6605		T,FLP,F(Unk) (Unk)P,CLA, VF	RET-30	Direct
0948A	Dry Only		2400							
0948C	Wet & Dry	1959	4000	3204	1124	135			RUP-88	-
								T,VF,RTP, (NA),(FLP)		

TABLE III-1
GENERAL SUMMARY TABLE
SINTERING
PAGE 3

* : Wastewater generated at sinter quench station.

**: Plant has converted to a wet system since receipt of the DCP data. Recycle system blowdown is co-treated with ironmaking wastewaters.

[ ]: The data enclosed in brackets represents information obtained during sampling visits or from D-DCP responses.

( ): Components enclosed in parentheses were installed after 1/1/78.

Legend

FLO(1): Flocculation with ferrous sulfate.

NOTE: For definitions of the C&TT codes, refer to Table VII-2.

TABLE III-2

SINTERING DATA BASE

	Number of Plants	Percent of Total Number of Plants	Rated Plant Capacity (tons/year)	Percent of Total Annual Capacity
Plants sampled during the original guidelines survey	4	12.1	5,238,480	9.8
Plants sampled for the toxic pollutants survey	3*	9.1*	5,084,450	9.6
Plants which responded via D-DCP	5	15.2	9,654,250	18.1
Plants sampled and/or responding via D-DCP**	11	33.3	17,604,680	33.1
"Wet" plants	20	57.1	30,599,775	57.8
Plants which responded to the DCP's**	33	100.0	53,221,380	100.0

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* : One plant sampled during original study was resampled.

**: Excludes one confidential plant and the one plant no longer in operation.

TABLE III-3

SINTERING
RATED PRODUCTION CAPACITY (TONS/DAY)

	PLANT CODE	PRODUCTION CAPACITY
Plants generating wastewaters	0060	2,640
	0060B	2,400
	0060F	1,360
	0112A	12,200
	0112B	4,000
	0112C	2,683
	0112D	6,070
	0396A	3,312
	0432A	6,500
	0448A	3,850
	0492A	1,900
	0584C	3,800
	0584F	8,187
	0856F	7,200
	0856Q	500
	0864A	2,910
	0868A	7,783
	0920B	1,000
	0920F	1,500
	0946A	540
	0948C	4,000
		84,335 SUBTOTAL
Dry Plants	0112	6,145
	0384A	4,000
	0432C	2,500
	0584B	4,600
	0684B	Unk
	0684I	1,500
	0856J	15,000
	0856N	1,132
	0856T	5,000
	0860B*	16,600
	0860H	5,000
	0948A	2,400
		63,877 SUBTOTAL
		148,212 TOTAL

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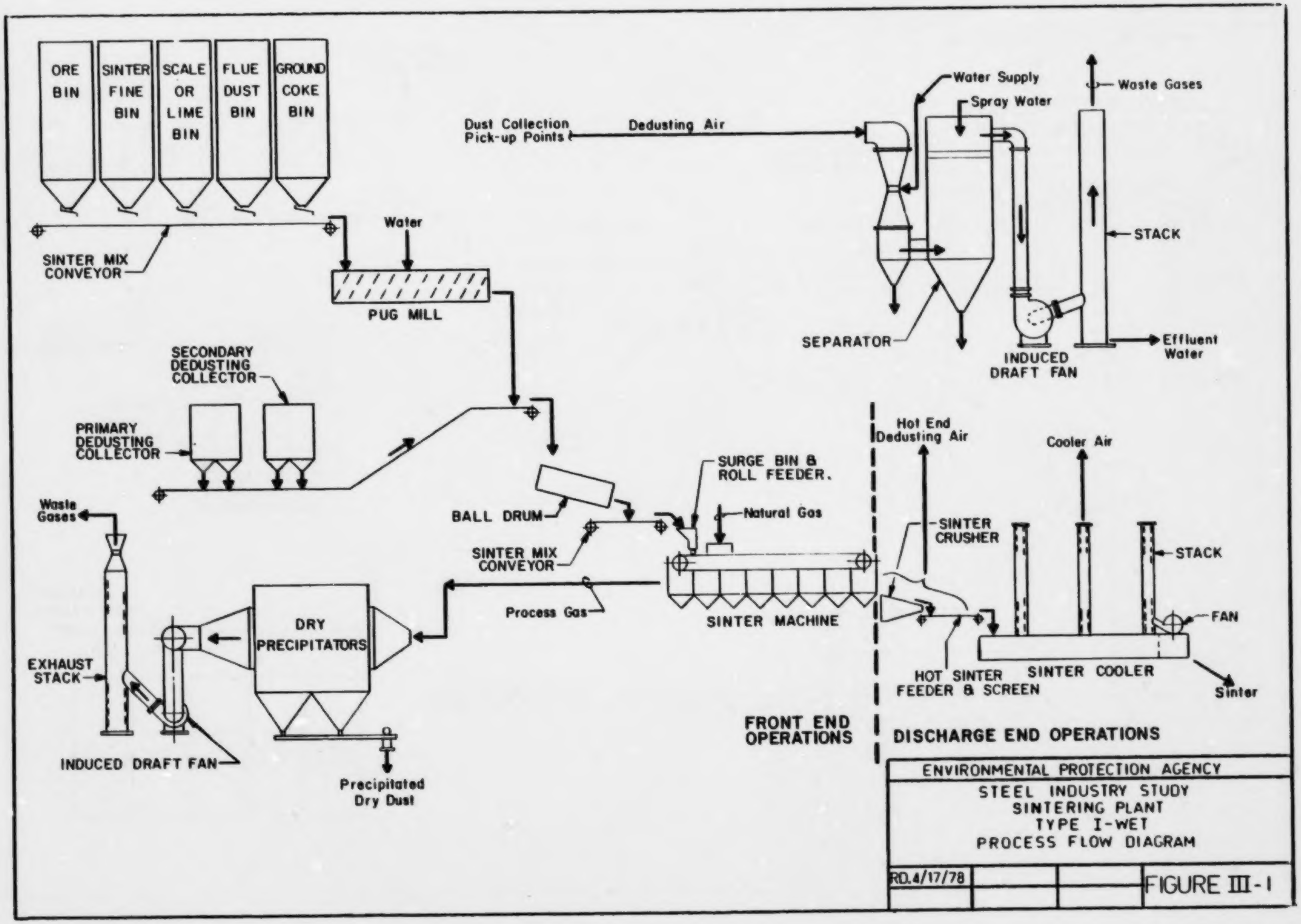
*: Plant has been retrofitted with wet air pollution control systems.

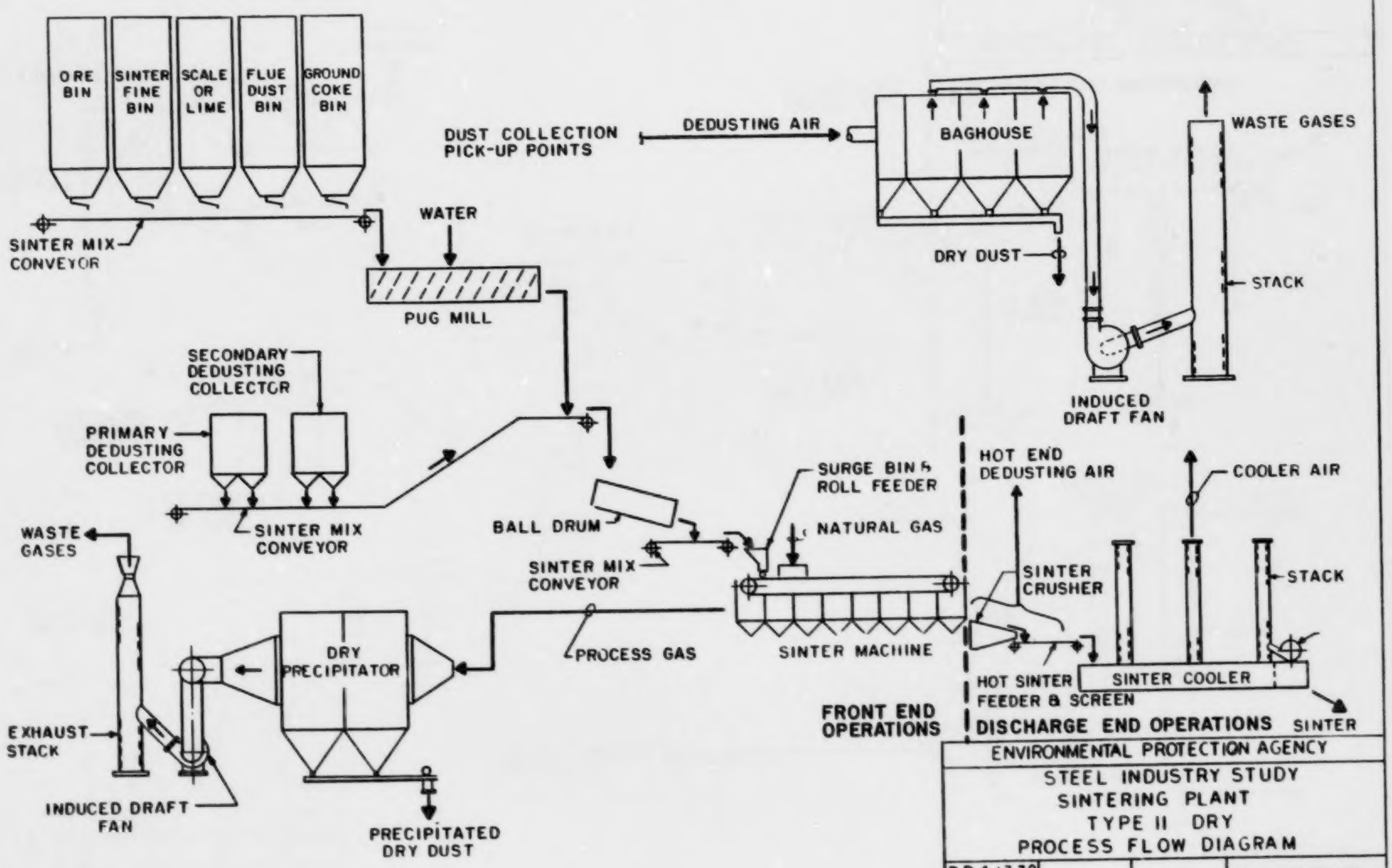

ORE BIN
SINTER FINE BIN
SCALE OR LIME BIN
FLUE DUST BIN
GROUND COKE BIN
SINTER MIX CONVEYOR
Water
PUG MILL
SECONDARY DEDUSTING COLLECTOR
PRIMARY DEDUSTING COLLECTOR
BALL DRUM
SINTER MIX CONVEYOR
SURGE BIN & ROLL FEEDER.
Natural Gas
SINTER MACHINE
Process Gas
DRY PRECIPITATORS
Precipitated Dry Dust
INDUCED DRAFT FAN
EXHAUST STACK
Waste Gases
Dust Collection Pick-up Points
Dedusting Air
Water Supply
Spray Water
Waste Gases
STACK
SEPARATOR
INDUCED DRAFT FAN
Effluent Water
Hot End Dedusting Air
SINTER CRUSHER
Cooler Air
STACK
FAN
HOT SINTER FEEDER & SCREEN
SINTER COOLER
Sinter
FRONT END OPERATIONS
DISCHARGE END OPERATIONS

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
SINTERING PLANT
TYPE I-WET
PROCESS FLOW DIAGRAM

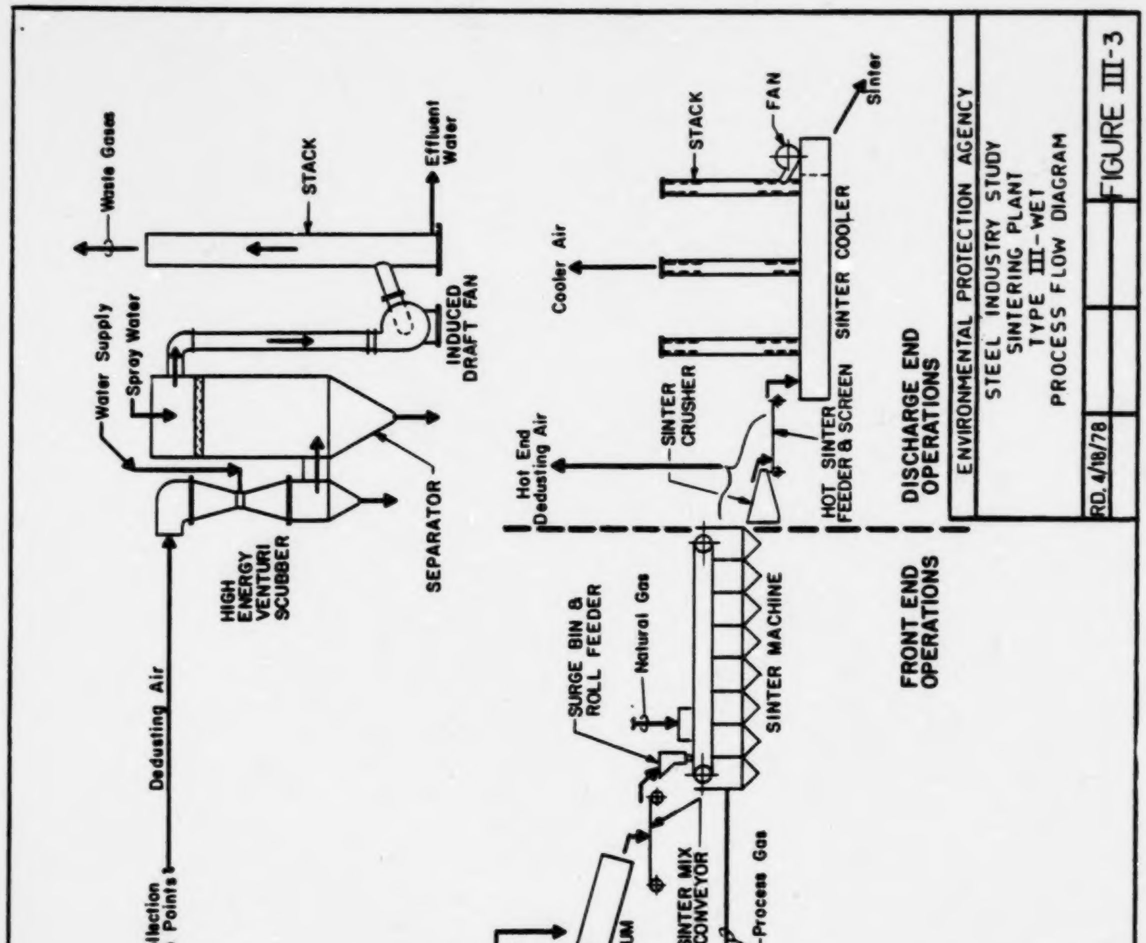
RD.4/17/78

FIGURE III-1


ORE BIN
SINTER FINE BIN
SCALE OR LIME
FLUE DUST BIN
GROUND COKE BIN
SINTER MIX CONVEYOR
WATER
PUG MILL
DUST COLLECTION PICK-UP POINTS
DEDUSTING AIR
BAGHOUSE
WASTE GASES
DRY DUST
STACK
INDUCED DRAFT FAN
SECONDARY DEDUSTING COLLECTOR
PRIMARY DEDUSTING COLLECTOR
SINTER MIX CONVEYOR
BALL DRUM
SURGE BIN & ROLL FEEDER
NATURAL GAS
SINTER MIX CONVEYOR
HOT END DEDUSTING AIR
COOLER AIR
SINTER CRUSHER
STACK
WASTE GASES
EXHAUST STACK
INDUCED DRAFT FAN
DRY PRECIPITATOR
PRECIPITATED DRY DUST
PROCESS GAS
SINTER MACHINE
HOT SINTER FEEDER & SCREEN
SINTER COOLER
SINTER
FRONT END OPERATIONS
DISCHARGE END OPERATIONS

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
SINTERING PLANT
TYPE II DRY
PROCESS FLOW DIAGRAM
RD 4-17-78

FIGURE III-2


ORE BIN
SINTER FINE BIN
SCALE OR LIME BIN
FLUE DUST BIN
GROUND COKE BIN
Sinter Mix Conveyor
Water
PUG MILL
SECONDARY DEDUSTING COLLECTOR
PRIMARY DEDUSTING COLLECTOR
SINTER MIX CONVEYOR
BALL DRUM
Dust Collection Pick-up Points
Dedusting Air
SINTER MIX CONVEYOR
Process Gas
SURGE BIN & ROLL FEEDER
Natural Gas
SINTER MACHINE
HIGH ENERGY VENTURI SCUBBER
SEPARATOR
Water Supply
Spray Water
INDUCED DRAFT FAN
STACK
Waste Gases
Effluent Water
Water Supply
HIGH ENERGY VENTURI SCRUBBER
SEPARATOR
Spray Water
INDUCED DRAFT FAN
STACK
Waste Gases
Effluent Water
Hot End Dedusting Air
SINTER CRUSHER
HOT SINTER FEEDER & SCREEN
Cooler Air
STACK
FAN
Sinter
SINTER COOLER
FRONT END OPERATIONS
DISCHARGE END OPERATIONS
RD. 4/18/78

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
SINTERING PLANT
TYPE III-WET
PROCESS FLOW DIAGRAM

FIGURE III-3

SINTERING SUBCATEGORY

SECTION IV

SUBCATEGORIZATION

The basic steelmaking segment of the basic steel industry is comprised of several separate and distinct processes. The Agency found that individual processes, products and wastewater characteristics affect industry subcategorization. Based upon a review of the factors mentioned above, the Agency has established sintering as an individual subcategory. Several factors were evaluated to determine if the sintering subcategory requires further subdivision. The Agency concludes, however, that further subdivision is not warranted. The factors reviewed in reaching these conclusions are discussed below.

Manufacturing Process and Equipment

Sintering is unique in that it is the only process in which iron bearing fines (such as mill scale and flue dust from other steel operations) are mixed with other materials and combusted to form an agglomerate. The agglomerate, in turn, is used as a raw material for the ironmaking process. Because no other ironmaking or steelmaking process is similar, the Agency determined that the establishment of a sintering subcategory is appropriate.

Despite the various combinations of raw materials which are fed to the sintering operation, the process operation does not vary significantly from plant to plant. The basic process includes raw material mixing, ignition and combustion, agglomeration of the sinter, cooling and screening. The Agency determined that no further subdivision of this subcategory is warranted on the basis of manufacturing process differences.

Final Product

Sintering produces only one final product. This final product may vary in physical and chemical makeup among plants, but these differences are slight and of little importance to subdivision. The Agency determined that differences in final product do not warrant further subdivision of the sintering subcategory.

Raw Materials

The raw materials used in the sintering process consist of ores, mill scale, coke, limestone, slag fines and sludges (Table IV-1). The availability of these materials at each location determines the raw materials used at that facility. Although the composition of the raw materials may vary from plant to plant, the Agency found that these variations do not significantly affect process wastewaters. The model treatment systems evaluated by the Agency provide for effective

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control of the various sintering process wastewater pollutants. Accordingly, the Agency concluded that these differences do not warrant further subdivision of this subcategory.

Wastewater Characteristics

The wastewaters generated at sintering operations result primarily from the scrubbing of the process gases and dusts. Although the nature of the wastewaters may vary as a result of their origin in the sintering process, similar pollutants are found in all sintering wastewaters. For example, oil and grease and suspended solids are common in all sintering wastewaters, as are cyanide, fluoride, sulfide, phenols, and various toxic metals. Although these pollutants may be found in varying levels, the range of concentrations and loadings are not so large as to warrant further subdivision. Multiple sintering operation wastewater sources are combined at many plants for treatment (e.g., windbox, discharge end). Based upon the factors presented above, the Agency determined that further subdivision based upon wastewater characteristics is not warranted.

Wastewater Treatability

As noted for BPT, a concern in the treatment of sintering operation wastewaters is the removal of suspended solids, which in turn results in a reduction in the levels of those pollutants which comprise the suspended solids. This reduction in suspended solids is accomplished by using sedimentation technology. Except for one plant (which discharged to a blast furnace gas scrubbing recycle system), all plants have similar wastewater treatment systems. For treatment of toxic pollutants at the BAT level, the Agency considered several wastewater treatment technologies including filtration, precipitation, and alkaline chlorination. The Agency does not believe plant to plant variations in wastewater characteristics affect wastewater treatability. Accordingly, the Agency determined that further subdivision based upon wastewater treatability is not warranted.

Size and Age

The Agency considered the effect of size and age on the subdivision of sintering operations. Its analysis of the impact of size and age on such elements as wastewater generation, discharge flow rate (associated with the ability to recycle), and the ability and costs to install treatment did not demonstrate a need for further subdivision.

The question of further subdivision on the basis of age was addressed by comparing plant age and discharge flow data. Discharge flow was used as an indication of wastewater treatment capability, since the wastewater characteristics and treatability are similar for all sintering operations. Figure IV-1 is a plot of discharge flow vs. plant age for all plants, while Figure IV-2 presents a plot of discharge flow vs. plant age for only those plants with treatment and recycle facilities. The low discharge flows exhibited at some of the oldest plants (representing the ability to provide adequate basic treatment) indicates that further subdivision of this subcategory on the basis of age is not appropriate. In addition, pollution control equipment can be retrofitted to existing plants as demonstrated by the plants noted on Table IV-2. The industry did not report significant retrofit costs for either older or newer sintering operations. For the eleven plants (55% of the "wet" sinter plants) listed on this table, the time between the first year of production and the year of major water pollution control equipment installation varies from six years to thirty-three years.

The question of size was evaluated by comparing the rated capacity (size) of each plant with its discharge flow. Figure IV-3 presents a plot of discharge flow vs. plant rated production capacity for all plants, while Figure IV-4 presents a plot of discharge flow vs. plant rated production capacity for only those plants with treatment and recycle facilities. The distribution of the data meeting or exceeding the BPT model flow indicates that plant size does not affect the ability to provide wastewater treatment. The points are widely distributed from small to large plants.

Based upon the above, the Agency finds that both old and newer production facilities generate similar raw wastewater pollutant loadings; that pollution control facilities can be and have been retrofitted to both old and newer production facilities without substantial retrofit costs; that these pollution control facilities can and are achieving the same effluent quality; and, that further subcategorization or further segmentation within this subcategory on the basis of age or size is not appropriate.

Geographic Location

Most of the sinter plants are located in the East and Midwest. Only one plant (which has recycle facilities installed) is located in either an arid or semi-arid region. Most plants have wastewater recirculation as an integral part of treatment. These plants are not restricted on the basis of geographic location. Accordingly, the Agency concluded that further subdivision on the basis of geographic location is not warranted.

Process Water Usage

Process water usage varies from plant to plant depending primarily upon the type and number of "wet" scrubbers in use. However, wastewater quality for all operations is similar and all wastewaters from each plant are combined for treatment. In addition, low discharge flows from the sintering operations are achieved by plants having both high and low applied flow rates. Hence, the Agency concluded that further subdivision based upon process water usage rates is not warranted.

TABLE IV-1

RAW MATERIALS SUMMARY FOR SINTERING OPERATIONS GENERATING WASTEWATERS

(Percent of total raw material feed)

			IRON SOURCES		
PLANT NO.	FUEL(1)	FLUXES(2)	ORES(3)	IRON BEARING(4) MATERIALS	ALL IRON SOURCES
0060	3.9	22.0	33.5	40.6	74.0
0060B	2.2	20.7	25.1	52.1	77.1
0060F	2.0	15.5	24.4	58.0	82.5
0112A	4.9	18.0	70.2	6.9	77.1
0112B	5.0	20.0	45.0	30.0	75.0
0112C	4.6	17.5	63.0	14.9	77.9
0112D	2.6	15.6	39.5	42.3	81.8
0396A	4.3	22.6	67.5	5.6	73.1
0432A	4.1	28.7	53.8	13.4	67.2
0448A	5.0	18.6	72.9	3.4	76.4
0492A	4.1	16.9	60.4	18.6	79.0
0584C	7.0	19.0	46.0	28.0	74.0
0584F	9.0	32.5	50.7	7.8	58.5
0856F	6.0	17.0	58.0	19.0	77.0
0856Q	5.6	-	76.0	18.5	94.4
0864A	6.2	11.8	75.9	6.0	82.0
0868A	5.7	15.8	75.1	3.4	78.5
0920B	13.2	24.9	29.6	32.4	61.9
0920F	-	26.4	37.0	36.7	73.6
0946A	3.0	-	50.6	46.4	97.0
0948C	3.9	35.7	43.0	17.5	60.4

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(1) Includes coke and coke breeze.

(2) Includes limestones, dolomite, sand, stone fines, calcined fines, etc.

(3) Includes iron ore, ore fines, pellet fines, taconite fines, etc.

(4) Includes mill scale, flue dust, metallic fines, sludges, filter cakes, slags, sinter, etc.

TABLE IV-2

EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED THE ABILITY TO RETROFIT WATER POLLUTION CONTROL EQUIPMENT SINTERING SUBCATEGORY

Plant Reference Code	Plant Age - First Year of Production	Treatment Age - Year of Installation Major Components
0060B	1958	1968
0060F	1957	1975
0112B	1950	1970
0112C	1948	1960
0448A	1943	1971
0548C	1959	1965
0584C	1959	1965
0864A	1944	1962
0868A	1941	1954
0920F	1944	1973
0946A	1939	1972

FIGURE IV-1
DISCHARGE FLOW vs. PLANT AGE
SINTERING
ALL PLANTS

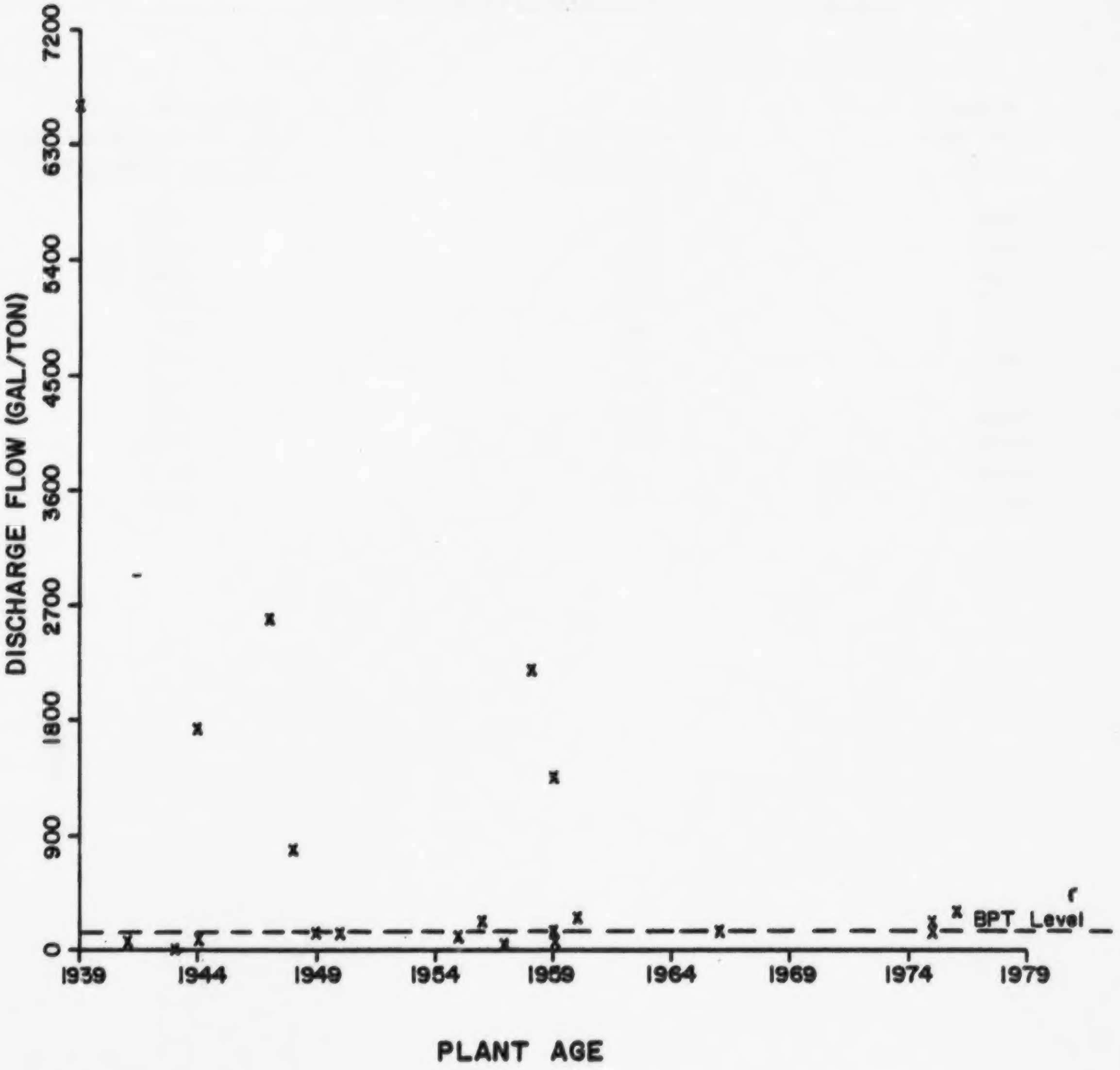


FIGURE IV-2
DISCHARGE FLOW vs. PLANT AGE
SINTERING

PLANTS THAT RECYCLE

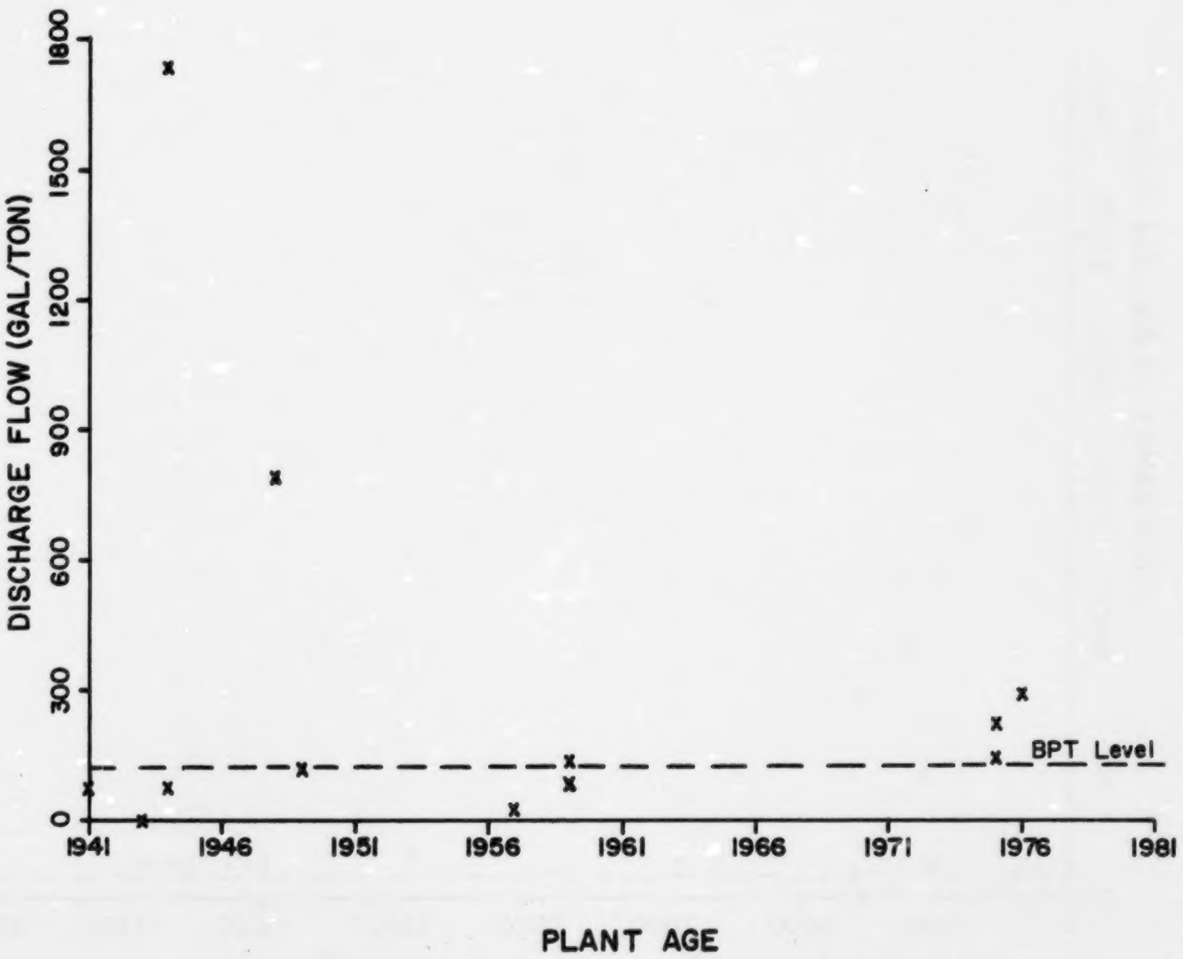


FIGURE IV-3
DISCHARGE FLOW vs. PLANT RATED PRODUCTION CAPACITY
SINTERING
ALL PLANTS

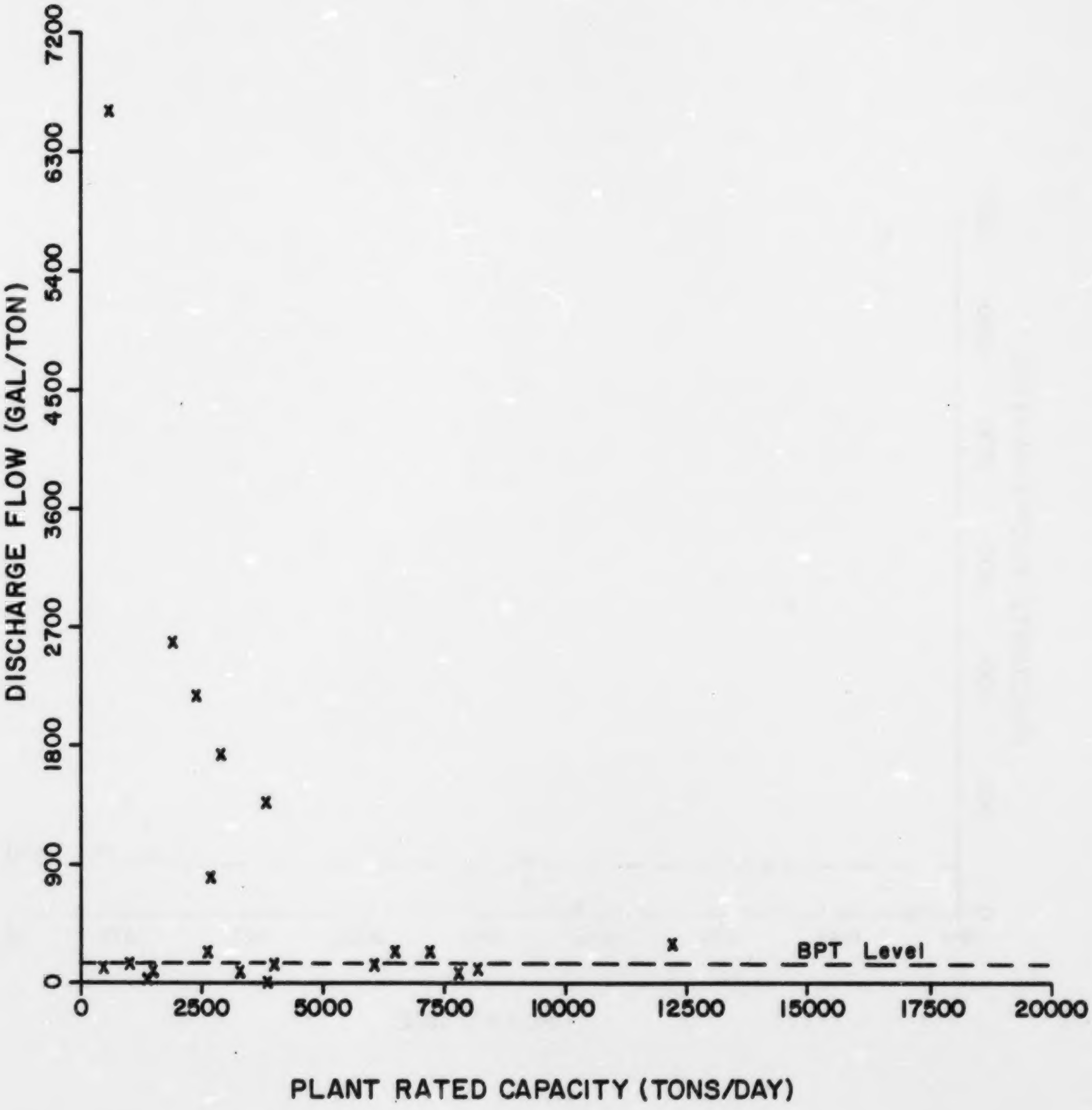
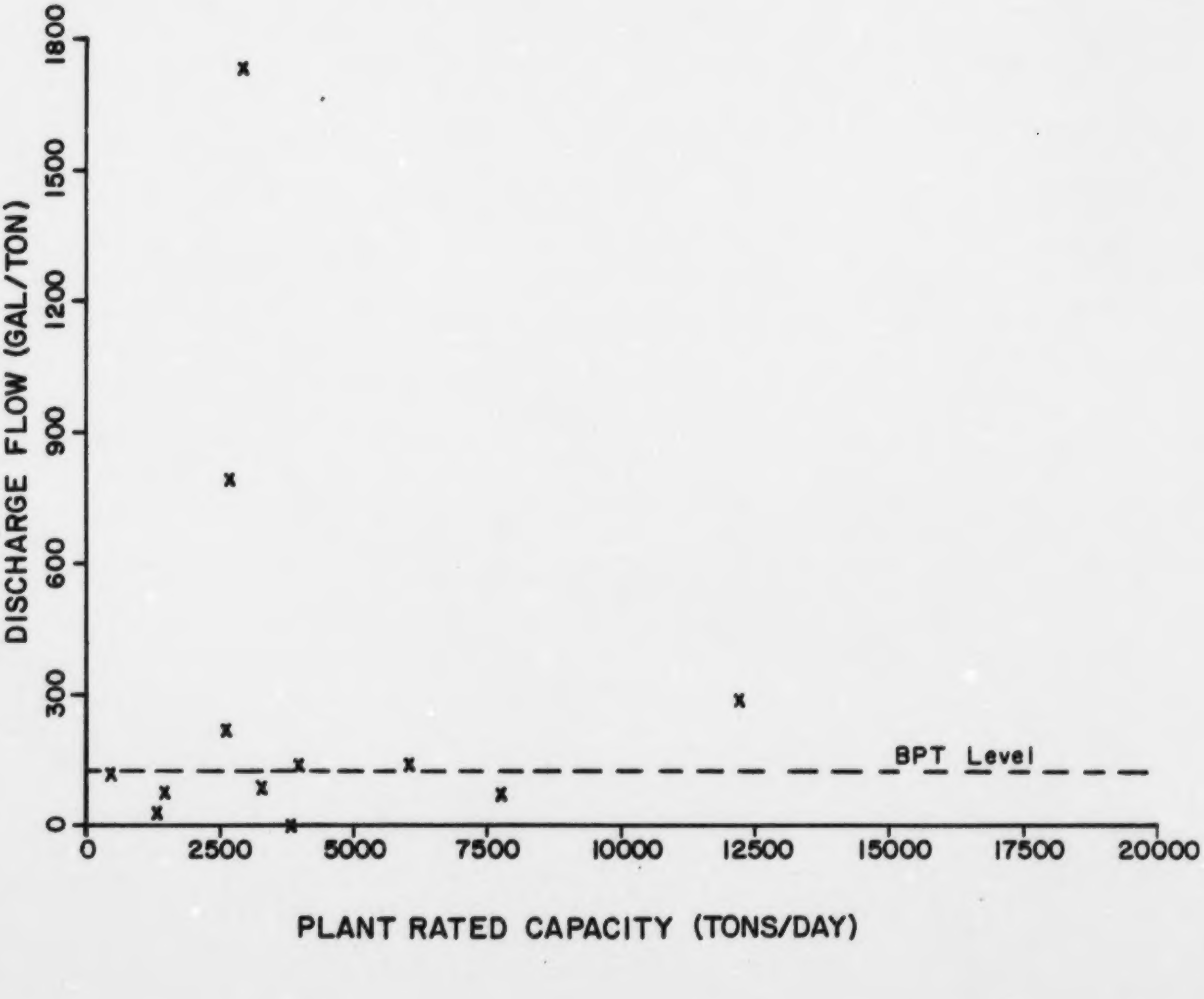


FIGURE IV-4
DISCHARGE FLOW vs. PLANT RATED PRODUCTION CAPACITY
SINTERING
PLANTS THAT RECYCLE



SINTERING SUBCATEGORY

SECTION V

WATER USE AND WASTEWATER CHARACTERIZATION

Introduction

Process water usage is a significant factor in determining the pollutant loads and in estimating the cost of removing those pollutants generated by sintering operations. The importance of carefully controlling process water usage cannot be overemphasized. The Agency used data from the sampling visits and DCPs to evaluate process water use, pollutant discharges, total wastewater volumes, and to identify existing control and treatment technologies.

Wastewater characterization is based upon data obtained during the field sampling programs. During the original guidelines survey, the Agency investigated the levels of limited pollutants (suspended solids, oil and grease and pH) in the process wastewaters. During the second field sampling program, the Agency again investigated the levels of the previously limited pollutants and performed additional monitoring for toxic inorganic and organic pollutants.

The water use rates discussed below pertain only to process wastewaters. Noncontact cooling or nonprocess waters are not included. Process wastewaters are those waters which come into direct contact with the process, product, by-products, or raw materials. Noncontact cooling waters are cooling waters which do not directly contact the processes, products, by-products, or raw materials. Nonprocess waters are those waters which are used for nonprocess operations, e.g., utility and maintenance department requirements.

Description of Sinter Plant Wastewater Sources

As noted earlier, sintering process wastewaters result from dust and gas scrubbing equipment and from sinter cooling and quenching. Some newer plants are equipped with "dry" air pollution equipment while many older plants are equipped with "wet" systems. Sinter plant gas and dust scrubbing equipment is generally separated into two systems. One of the systems scrubs the fumes and dusts from the hot sinter bed, ignition furnace, and sinter bed wind boxes, while the other system controls emissions from the sinter crushers, sinter fines conveyors, raw material storage bins, and feeders. As can be noted in Table III-1, however, common industry practice is to combine the various wastewater streams for treatment.

Industry responses to the DCPs provided process wastewater and treated effluent flow data. In many instances the flow rates were reported as measured values, but in other instances the flows were reported as design rates or rates based upon best engineering judgment. Where

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available, plant visit or D-DCP flow data were included in Table III-1 in lieu of DCP data.

Raw process wastewater flows ranged from 417 l/kkg (100 gallons/ton) of sintered product to 27,543 l/kkg (6605 gallons/ton). The lowest flow, for sinter cooling water, was observed at a plant with dry air pollution equipment. Other plants exhibited similar process wastewater flows (e.g., 106, 133 and 134 gal/ton). Two of these plants have as many as four scrubbers.

Plant effluent flows also varied over a wide range, i.e., 108 l/kkg (26 gallons/ton) to 27,543 l/kkg (6605 gallons/ton). The lowest effluent flow was observed at a plant which discharges only a thickener underflow. In this system, the thickener overflow is completely recycled. The wide range in flows can be attributed to several factors, but the number of scrubbers and the scrubber design and efficiency influence water usage rates.

One method of conserving water and reducing the quantities of discharged pollutants is the recirculation of partially treated wastewaters. Wastewater recirculation is currently practiced at more than 12 sinter plants and is a major component of the BPT model treatment system. Although wastewater recirculation can result in increased levels of certain pollutants in recycled wastewaters, the significant reduction in total discharge flow results in an overall reduction in discharged pollutant loads.

Sintering wastewaters contain large quantities of suspended particulate matter and oil and grease. In addition, toxic inorganic and organic pollutants and fluoride were found in sintering wastewaters at significant levels. The concentration data presented in Table V-1 provide a measure of the pollutant loads contributed by the process, thereby indicating which pollutants are significant with respect to sintering operations. After reviewing the raw waste and treated effluent levels of pollutants and the degree of recycling, the Agency determined that the effect of makeup water quality on the discharge is negligible. Accordingly, the Agency has decided to promulgate effluent limitations and standards which are based solely on gross values. Additional information on the effect of make-up water quality is presented at the end of Section VII.

TABLE V-1

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES AND TOXIC POLLUTANT SURVEYS
SINTERING

Pick-up per Pass Concentrations in Raw Process Wastewaters*

	Reference Code:	0432A	0396A	0112D	0432A	0060F$^{(1)}$
	Plant Code:	H	J	016	017	019
	Sample Point(s):	-	(1-Sludge)-(4+2)	(B+C)-(E+A)	D+E-A	B-(C+A)
	Flow, gal/ton:	-	341	1432	245	301
		mg/l	mg/l	mg/l	mg/l	mg/l
	Ammonia (N)	**	NA	NA	NA	NA
	Fluoride		1.2	3.1	6.2	17.3
	Oil and Grease		387	17.4	9.1	196
	Phenols (4AAP)		NA	0.131	0.045	0.064
	Sulfide		19,460	82	5345	745
39	Fluoranthene			0.031	0	-
59	2,4-Dinitrophenol			0.014	ND	ND
65	Phenol			0.007	-	0.556
73	Benzo(a)pyrene			0.023	0	-
76	Chrysene			0.020	0	0
84	Pyrene			0.029	0	-
118	Cadmium			0.006	0	0.116
119	Chromium			0.008	0.113	0.001
120	Copper			0.054	0.052	0.143
121	Cyanide (T)			0.0	0.038	0.177
122	Lead			0.54	0.197	-
124	Nickel			-	0	0.018
127	Thallium			NA	0.020	NA
128	Zinc			0.049	0.849	-

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* : Only those toxic pollutants found at concentrations greater than 0.010 mg/l are presented in this table.

** : No makeup water sample was obtained at this plant. Therefore, no determination of pick-up per pass concentrations could be completed.

NA : No analysis performed.

ND : Not Detected

- : Calculation results in a negative value.

(1): All toxic metals concentrations for this plant are expressed as dissolved values.

SINTERING SUBCATEGORY

SECTION VI

WASTEWATER POLLUTANTS

Introduction

A review of pollutants found in steel industry wastewaters and the general strategy for selecting pollutants for which limitations have been promulgated are presented in Volume I. The selection of limited pollutants for the sintering subcategory was based upon this process and on other factors pertaining to the sintering process and sintering wastewaters.

Rationale for Selection of Pollutants

The pollutants which the Agency found in sintering process wastewaters reflect the variety of sintering process raw materials (e.g., iron and steelmaking flue dust, ores, mill scale, coke, limestone, slag fines, and blast furnace thickener sludges). Fines and dust from all sources contribute to the suspended solids loadings. Oil and grease is present primarily as a result of the oils and greases carried into the process by the scrap and mill scales. Compounds detected in the oil and grease analysis can also result from the incomplete combustion of coke in the sintering process. The presence of fluoride is attributable to the use of lime fluxing agents and slag fines in sintering operations.

Particulates generated during the sintering process are transported in the process gases, and are removed by scrubbing with water. The solids found in the process wastewaters are comprised of several chemical constituents including various toxic pollutants. The removal of the suspended solids therefore results in the removal, to varying degrees, of a number of other pollutants (e.g., metals). Other pollutants (i.e., chloride, sulfate) are present at substantial levels in the process wastewaters, but are not included in the list of selected pollutants since they are not toxic and difficult to remove. Treatment for these pollutants is not commonly practiced in any industry.

The presence of toxic organic and inorganic pollutants is attributable to the raw materials used in the sintering process. Although the Agency detected phthalate compounds (e.g., butyl benzyl phthalate, di-n-butyl phthalate and di-n-octyl phthalate), it believes that their presence is due to sampling and analytical procedures. An evaluation of process conditions and operations provided no indication that phthalates are generated directly as a result of sinter production. The toxic metal pollutants found in the wastewaters originate in the iron bearing materials charged to the sinter machine. These

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pollutants contaminate the process wastewaters mainly as a result of scrubbing the particulates from the process gases.

This study also considered the levels of the other toxic pollutants. Initially, all pollutants classified as "known to be present" were included in the list of pollutants for the sintering process. The above classification was developed on the basis of responses to the DCPs, and analyses completed during the screening phase of the project. Table VI-1 lists these pollutants.

The Agency calculated a net concentration (reflecting the level of a pollutant contributed by the process) for each pollutant detected in the raw wastewaters at 0.010 mg/l or greater. Those pollutants found at an average net concentration of less than 0.010 mg/l were excluded from further consideration in the selection process. The list of selected pollutants is presented in Table VI-2. Although net concentrations were used for this analysis, the Agency established effluent limitations on a gross basis only (see Section V and Section VII).

TABLE VI-1

TOXIC POLLUTANTS KNOWN TO BE PRESENT SINTERING OPERATIONS

4	Benzene
23	Chloroform
39	Fluoranthene
59	2,4-Dinitrophenol
65	Phenol
72	Benzo(a)anthracene
73	Benzo(a)pyrene
76	Chrysene
84	Pyrene
85	Tetrachloroethylene
115	Arsenic
118	Cadmium
119	Chromium
120	Copper
121	Cyanide
122	Lead
124	Nickel
125	Selenium
126	Silver
127	Thallium
128	Zinc

TABLE VI-2

SELECTED POLLUTANTS
SINTERING

	pH
	Ammonia (N)
	Fluoride
	Oil and Grease
	Phenols (4AAP)
	Total Suspended Solids
39	Fluoranthene
65	Phenol
76	Chrysene
84	Pyrene
118	Cadmium
119	Chromium
120	Copper
121	Cyanide (T)
122	Lead
124	Nickel
128	Zinc

SINTERING SUBCATEGORY

SECTION VII

CONTROL AND TREATMENT TECHNOLOGY

Introduction

The model treatment systems for BPT, BAT, BCT, NSPS, PSES, and PSNS were established after determining current wastewater treatment practices in the industry. The various treatment technologies were formulated to supplement a primary level of treatment. Effluent limitations were established on the basis of effluent analytical data obtained during plant visits, D-DCP long-term analytical data, and the demonstrated capabilities of certain technologies. Treatment system summaries, schematics and wastewater analytical data for the visited plants are presented in this section.

Control and Treatment Technology - Sintering Operations

Most sintering wastewater treatment facilities currently provide treatment for suspended solids, although removal of other pollutants occurs incidentally. A summary of treatment practices noted during plant visits and reported in the DCPs follows.

a. Wastewaters from sixteen of the 21 "wet" sintering plants are treated in central treatment facilities. Five plants have separate treatment facilities which discharge directly to navigable waters. In almost all instances, the central treatment systems receive only ironmaking and sintering wastewaters. Treatment facilities at the five sintering plants with separate treatment systems are similar in design to the central treatment facilities. An evaluation of data from separate and central treatment systems indicates that similar flow rates, recycle rates, and effluent levels are achieved with either system. The treatment models presented herein are for separate treatment facilities, thus overstating treatment plant costs where co-treatment is practiced. Central treatment tends to decrease overall treatment costs. Table VII-1 presents a summary of pertinent data for plants discharging to central treatment facilities.

b. Sedimentation is the primary wastewater treatment technology applied to sintering operation wastewaters. Of the 21 "wet" sinter plants, sixteen are equipped with thickeners or clarifiers and five have settling lagoons. At eighteen plants, the sludge removed from thickeners is pumped to vacuum filters which are used to dewater the sludge. At several plants, the dewatered solids are returned to the sintering operation to recover iron values. The filtrate is returned to the thickener influent and the thickener effluent is either discharged or recycled. Five plants discharge treated wastewaters to other steel plant operations for reuse.

c. In order to enhance solids removal, various coagulant aids (principally polymeric flocculants) are added to the wastewaters prior to settling. These flocculants (used at seventeen plants) help to form larger, more readily settleable particles. Toxic inorganic and organic pollutant removal is incidental to suspended solids removal.

d. As mentioned above, five plants discharge treated wastewaters for reuse in other steel plant operations. Wastewater treatment at four of the five plants is provided at central treatment facilities. Also, treated effluent from four of the five plants is reused as make-up for blast furnace coolers and scrubbers. The effluent from one central treatment facility is reused at many other operations. In some of these systems, sinter process wastewater pollutants are diluted, rather than effectively treated.

e. Recycle of treated process wastewaters is practiced at twelve plants. Eight of these plants (five of which have separate treatment facilities) recycle treated effluents at rates varying from 30% to 100%. Three plants (one of which has a separate treatment facility) recycle both untreated and treated wastewaters at rates varying from 77% to 94%. The remaining plant recycles only untreated wastewaters at a rate of 88%. The basic recycle system includes sedimentation with vacuum filtration for sludge dewatering. Flocculating agents are used to enhance solids removal capabilities in some systems.

f. Alkaline chlorination is used at two plants to control cyanide. In both instances, sinter plant wastewaters are treated with blast furnace wastewaters in central treatment systems.

g. Filters are used at three plants for additional suspended solids removal. The sintering wastewaters are treated with ironmaking, steelmaking, or steel finishing wastewaters in thse systems.

h. One plant discharges the blowdown from a treatment and recycle system to a publicly owned treatment works (POTW). In this instance, sintering wastewaters make up 76% of the volume discharged to the POTW.

Control and Treatment Technologies Considered for Toxic Pollutant Removal

The treatment technologies which the Agency has considered for sintering wastewaters are described below. BAT, NSPS, PSES, and PSNS levels of treatment are reviewed in detail in subsequent sections.

a. Filtration

Filtration is generally used to further reduce the discharge of suspended solids. However, filtration can also be used to control those toxic pollutants which are entrained with the suspended solids. Filtration can be used as the last major component in a treatment system or to provide a polished feed stream to another treatment operation, e.g., adsorption on activated carbon. Particulate pollutant removal is accomplished by passing the wastewater stream, either under pressure or by gravity, through a filter media. The filter media, generally sand, anthracite coal and/or garnet, permits water to pass through but prevents the passage of much of the particulate matter suspended in the wastewater. The filter media itself may be comprised of a single type and size of media, various sizes of the same type of media, or a mixed media which contains several types and sizes of media.

b. Lime Precipitation and Sedimentation

Lime addition, followed by sedimentation, is used to further reduce the levels of toxic metals. This additional removal results from the formation of metal hydroxide precipitates which are subsequently removed in inclined plate separators. Inclined plate separators are gravity sedimentation devices in which the effective settling area is much larger than the area actually occupied by this equipment. This component has been demonstrated in this industry, in particular at Plant 0060F in this subcategory.

c. Alkaline Chlorination

The Agency considered alkaline chlorination for the treatment of sintering wastewaters based upon the use of this technology at several sinter plants which have combined and blast furnace wastewater treatment systems. The primary purpose of alkaline chlorination is to reduce the levels of cyanide in the wastewaters. It is also effective for oxidizing phenolics, other toxic organic pollutants, and ammonia-N.

Cyanide oxidation involves two basic reactions: the oxidation of cyanide to cyanate at a pH greater than 10, immediately followed by the further oxidation of the cyanate to carbon dioxide and nitrogen at a pH of 8.0-8.5. Cyanogen chloride is an intermediate product of the oxidation of cyanide to cyanate. Care must be taken to maintain wastewater pH greater than 10 in order to prevent the evolution of the toxic cyanogen chloride gas and to insure rapid and complete cyanide oxidation. It must be noted that chlorine consumption will be in excess of that predicted strictly on the basis of cyanide oxidation requirements due to the presence of other oxidizable pollutants. Chlorine can be added either in the gaseous state, through a chlorinator, or as a liquid (sodium hypochlorite).

Electrodes which measure the wastewater oxidation-reduction potential (ORP) can be used to control the chlorine feed to insure complete cyanide destruction. ORP is an electrochemical measurement, expressed as positive or negative millivolts, which can be used to determine the direction and rate of various oxidation or reduction reactions. In this application, the ORP would be maintained at a point indicative of rapid and essentially complete cyanide oxidation.

The effectiveness of this technology is reviewed in more detail in the ironmaking subcategory report with sampled plant, long-term, and pilot plant analytical data. Sinter plant wastewaters are similar in composition to blast furnace wastewaters in that both contain cyanide, phenols, and toxic metals. As a result, the application of alkaline chlorination to either waste stream should produce similar effluent quality. As noted previously, alkaline chlorination is applied to the combined sinter and blast furnace wastewaters.

d. Dechlorination

To minimize the potential toxicity of wastewaters which have been chlorinated, the Agency considered dechlorination as a treatment method to reduce total residual chlorine levels in the treated discharge. Dechlorination of a chlorinated central treatment plant effluent, which includes sintering, ironmaking and other process wastewaters, has been practiced since 1977 at Plant 0584E. This technology is also widely practiced in the electric power generation and electroplating industries. As one of the final treatment steps, dechlorination is generally effective on wastewaters generated by various sources. The Agency believes that it is equally effective when applied to sintering wastewaters. Reducing agents, such as sulfites or sulfur dioxide, are added to the chlorinated effluent in sufficient quantities to react with the excess residual chlorine, thereby forming nontoxic chlorides. This technology is added at the end of two-stage chlorination systems to minimize excess chlorine discharges.

e. Sulfide Precipitation

The addition of sulfide compounds in a wastewater treatment process may result in a higher degree of toxic metals removal than can be achieved with typical lime flocculation, precipitation or sedimentation procedures. Some of the metals which can be effectively precipitated with sulfide are zinc, copper, nickel, and lead, all of which are found in sintering wastewaters. The increased removal efficiencies are attributable to the relative solubilities of metal hydroxides and metal sulfides. In general, the metal sulfides are less soluble than the respective metal hydroxides. It must be noted, however, that an excess of sulfide in a treated effluent may result in objectionable odor problems, especially if the pH is less than 7.

One method of controlling the excess feeding of sulfide involves the addition of a ferrous sulfide slurry. As ferrous sulfide will not readily dissociate in the waste stream, the free sulfide level is kept well below objectionable limits. However, since the affinities of the other metals for sulfide are greater than that of iron, the other metal sulfide precipitates are formed preferentially to iron sulfide. Once the sulfide requirements for the other metal precipitates is satisfied, the remaining sulfide remains in the ferrous sulfide form and the excess iron from the ferrous sulfide is precipitated as a hydroxide. When used in conjunction with alkaline chlorination, sulfide addition will also consume excess chlorine following oxidation.

f. Removal of Toxic Organic Pollutants with Activated Carbon

Activated carbon has been used in many applications for the removal of toxic organic pollutants from wastewater streams. One of the more frequent uses is the reduction of COD and BOD concentrations in the effluent from sanitary treatment systems. Activated carbon is also used to remove toxic organic pollutants from wastewaters of various industrial operations including petroleum refining, organic chemicals, and cokemaking. Several toxic organic pollutants found in sintering wastewaters are also found in cokemaking wastewaters. This can be attributed to the use of coke in the sintering operation.

Operational guidelines for the use of activated carbon specify that where treatment of combined waste streams is involved or where the water to be processed has significant turbidity, preliminary treatment by clarification followed by filtration is required to achieve optimum performance. The use of chemical precipitation and diatomaceous earth filtration is sometimes required to achieve the clarity required for the removal of pollutants present at low levels. Particulates in wastewaters can adsorb organics and then release these organics after passage through the carbon bed.

Laboratory tests performed on single compound systems indicate that processing with activated carbon will achieve residual levels on the order of 1 microgram per liter for many of the organic compounds on the toxic pollutant list. Compounds which respond well to adsorption include chlorinated phenols, phenols, nitrophenols, and polynuclear aromatics.

Control of pH in the neutral range is necessary to minimize dissociation of both acidic and basic organic compounds. As a general rule, normal pH variations within the neutral range will not significantly affect the operation of activated carbon columns. It may also be noted that it may be impractical (as well as extremely expensive) to have two carbon adsorption systems in series, one operating at a low pH and the other at a high pH.

Data for existing industrial wastewater treatment applications indicate that activated carbon adsorption technology is transferrable to the treatment of sintering wastewaters. Refer to Sections VII and X of the ironmaking subcategory report and to Volume I for details regarding the capabilities of this technology. For specific details pertaining to sintering process wastewaters, refer to the pilot study and full-scale data presented in the ironmaking report. Since sintering and ironmaking wastewaters are similar and are often treated together, data for the treatment of ironmaking wastewaters can be applied in the development of effluent limitations for sintering operations as well as for ironmaking operations.

g. Vapor Compression Distillation

Vapor compression distillation is the process by which zero discharge can be achieved. In this process the wastewater is evaporated, concentrating the constituents in the wastewater to slurry consistency. The steam distillate is recondensed and recycled back to the process. The slurry discharge can be dried in a mechanical drier or allowed to crystallize in a small solar or steam-heated pond prior to final disposal. One desirable feature of the process is its relative freedom from scaling. Because of the unique design of the system, calcium sulfate and silicate crystals grow in solution as opposed to depositing on heat transfer surfaces. Economic operation of the systems requires a high calcium to sodium ratio (hard water).

Plant Visit Analytical Data

Table VII-2 presents the definitions for the various control and treatment technology and operating mode abbreviations. Table VII-3 presents a summary of raw wastewater data from sintering operations visited during both the original guidelines and toxic pollutant surveys. Table VII-4 presents a summary of effluent data from sintering operations visited during both the original guidelines and toxic pollutant surveys. Table VII-5 presents a summary of long-term effluent data provided in the D-DCP responses.

Plant Visits

The Agency sampled the wastewaters from seven sintering plants. Since complete data could not be obtained from three of the plants visited during the original guidelines survey, the limited data were of little value in determining wastewater treatment performance in these instances. A brief description of each of the visited plants is presented below. Schematic diagrams of the respective treatment facilities are presented at the end of this section.

Plant H (0432A) - Figure VII-1

Wastewaters from the sinter plant are mixed with wastewaters from the blast furnace and other sources, and then treated for suspended solids removal with polymer addition and sedimentation in thickeners. The thickener overflow is discharged to a receiving stream, while the underflow is dewatered with vacuum filters.

Plant I (0291C) - Figure VII-2

Wastewaters from the sinter plant are mixed with blast furnace wastewaters and treated in a thickener to remove suspended solids. The thickener underflow is dewatered with a vacuum filter, with the filtrate being returned to the thickener. The thickener overflow undergoes further treatment including alkaline chlorination and filtration. This effluent is discharged to the main plant pumping station, mixed with make-up water and reused.

Plant J (0396A) - Figure VII-3

Sinter plant scrubber wastewaters are combined with the underflow from the blast furnace treatment system thickener and treated in a second thickener. Most of the overflow is recycled to the sinter plant gas scrubber system. A cooling tower in the recycle line reduces the recycled wastewater temperature. A portion of the overflow is discharged to a POTW.

Plant 016 (0112D) - Figure VII-4

Wastewaters from the sinter mixing drum and sinter machine scrubbers are combined in a moisture eliminator cone, which acts as a settling chamber. The supernatant of the eliminator is recycled to the sinter machine scrubbers, while the underflow is discharged to a central treatment system where further treatment is provided.

Plant 017 (0432A) - Figure VII-5

Wastewaters from six sinter process scrubbers are mixed with blast furnace wastewaters and treated to remove suspended solids in a thickener. The thickener overflow is further treated by means of chlorination and sedimentation in a second thickener and then discharged.

Plant 019 (0060F) - Figure VII-6

Sinter plant wastewaters are treated by adding lime to aid precipitate formation. The floc is settled in a "Lamella" thickener. The overflow is mixed with make-up water and recycled to the steam hydro-scrubbers. The underflow is discharged to a blast furnace clarifier for further treatment.

Effect of Make-up Water Quality

The Agency believes that where the mass loading of a limited pollutant in the make-up water to a process is small in relation to the raw waste loading of that pollutant, the impact of make-up water quality on wastewater treatment system performance is not significant, and, in many cases, is not measureable. In these instances, the Agency has determined that the respective effluent limitations and standards should be developed and applied on a gross basis.

As shown in Table VII-6, the effect of make-up water quality for sintering operations is not significant when compared to raw waste loadings for the limited pollutants. Thus, the Agency has determined the applicable effluent limitations and standards should be applied on a gross basis, except to the extent provided by 40 CFR 122.63 (h).

TABLE VII-1

SUMMARY OF DATA FOR SINTERING OPERATIONS DISCHARGING TO CENTRAL TREATMENT FACILITIES

Plant Code	Applied Flow (gal/ton)	Discharge Flow (gal/ton)	Discharge Percent of Total Flow	Contributing Wastewater Sources
0060	1667	219	46	Blast Furnace
0060B	2186	2186	5	Blast Furnace, etc.
0112A	1604	288	83	Miscellaneous
0112B	133	133	28	Blast Furnace and BOF Sludges
0112C	1292	793	39	Blast Furnace
0112D	1432	142	2	General Plant Sources
0396A	341	85	76	Blast Furnace Sludges
0432A	245	245	6	Blast Furnace
0492A	2582	2582	11	General Plant Sources
0584C	1368	1368	1	BOF, Finishing
0584F	106	106	Unk	Blast Furnace
0856Q	2805	117	1	Blast Furnace
0920B	134	134	3	Blast Furnace
0946A	6605	6605	5	Blast Furnace
0948C	1124	138	-	Blowdown to Blast Furnace Blast Furnace

Unk: Unknown

TABLE VII-2

OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS

Symbols

A. Operating Modes

1. OT Once-Through

2. Rt,s,n Recycle, where t = type waste
s = stream recycled
n = % recycled

t: U = Untreated
T = Treated

	s	n
P	Process Wastewater	% of raw waste flow
F	Flume Only	% of raw waste flow
S	Flume and Sprays	% of raw waste flow
FC	Final Cooler	% of FC flow
BC	Barometric Cond.	% of BC flow
VS	Abs. Vent Scrub.	% of VS flow
FH	Fume Hood Scrub.	% of FH flow

3. REt,n Reuse, where t = type
n = % of raw waste flow

t: U = before treatment
T = after treatment

4. BDn Blowdown, where n = discharge as % of raw waste flow

B. Control Technology

10. DI Deionization

11. SR Spray/Fog Rinse

12. CC Countercurrent Rinse

13. DR Drag-out Recovery

C. Disposal Methods

20. H Haul Off-Site

21. DW Deep Well Injection

TABLE VII-2
OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS
PAGE 2

C. Disposal Methods (cont.)

22.	Qt,d	Coke Quenching, where t = type d = discharge as % of makeup t: DW = Dirty Water CW = Clean Water
23.	EME	Evaporation, Multiple Effect
24.	ES	Evaporation on Slag
25.	EVC	Evaporation, Vapor Compression Distillation

D. Treatment Technology

30.	SC	Segregated Collection
31.	E	Equalization/Blending
32.	Scr	Screening
33.	OB	Oil Collecting Baffle
34.	SS	Surface Skimming (oil, etc.)
35.	PSP	Primary Scale Pit
36.	SSP	Secondary Scale Pit
37.	EB	Emulsion Breaking
38.	A	Acidification
39.	AO	Air Oxidation
40.	GF	Gas Flotation
41.	M	Mixing
42.	Nt	Neutralization, where t = type t: L = Lime C = Caustic A = Acid W = Wastes O = Other, footnote

TABLE VII-2
OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS
PAGE 3

D. **Treatment Technology (cont.)**

43.	FLt	Flocculation, where t = type t: L = Lime A = Alum P = Polymer M = Magnetic O = Other, footnote
44.	CY	Cyclone/Centrifuge/Classifier
44a.	DT	Drag Tank
45.	CL	Clarifier
46.	T	Thickener
47.	TP	Tube/Plate Settler
48.	SLn	Settling Lagoon, where n = days of retention time
49.	BL	Bottom Liner
50.	VF	Vacuum Filtration (of e.g., CL, T, or TP underflows)
51.	Ft,m,h	Filtration, where t = type m = media h = head

t	m	h
D = Deep Bed	S = Sand	G = Gravity
F = Flat Bed	O = Other, footnote	P = Pressure

52.	CLt	Chlorination, where t = type t: A = Alkaline B = Breakpoint
53.	CO	Chemical Oxidation (other than CLA or CLB)

TABLE VII-2
OPERATING MODES, CONTROL AND TREATMENT
TECHNOLOGIES AND DISPOSAL METHODS
PAGE 4

D. Treatment Technology (cont.)

54.	BOt	Biological Oxidation, where t = type t: An = Activated Sludge n = No. of Stages T = Trickling Filter B = Biodisc O = Other, footnote
55.	CR	Chemical Reduction (e.g., chromium)
56.	DP	Dephenolizer
57.	ASt	Ammonia Stripping, where t = type t: F = Free L = Lime C = Caustic
58.	APt	Ammonia Product, where t = type t: S = Sulfate N = nitric Acid A = Anhydrous P = Phosphate H = Hydroxide O = Other, footnote
59.	DSt	Desulfurization, where t = type t: Q = Qualification N = Nonqualifying
60.	CT	Cooling Tower
61.	AR	Acid Regeneration
62.	AU	Acid Recovery and Reuse
63.	ACt	Activated Carbon, where t = type t: P = Powdered G = Granular
64.	IX	Ion Exchange
65.	RO	Reverse Osmosis

TABLE VII-2
OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS
PAGE 5

D. Treatment Technology (cont.)

66.	D	Distillation
67.	AAl	Activated Alumina
68.	OZ	Ozonation
69.	UV	Ultraviolet Radiation
70.	CNTt,n	Central Treatment, where t = type n = process flow as % of total flow t: 1 = Same Subcats. 2 = Similar Subcats. 3 = Synergistic Subcats. 4 = Cooling Water 5 = Incompatible Subcats.
71.	On	Other, where n = Footnote number
72.	SB	Settling Basin
73.	AE	Aeration
74.	PS	Precipitation with Sulfide

TABLE VII-3

RAW WASTEWATERS - SINTERING
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES AND TOXIC POLLUTANT SURVEYS

PLANT CODES	0432A		0396A		0112D		0432A		0060F(1)		AVERAGES	
	H		J		016		017		019			
Sample Point(s)	6		1 - Sludge		B+C		D+E		B			
Flow, gal/ton	104		341		1432		245		301			
	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs
pH	9.6		12.7		7.1 - 12.3		10.9 - 12.6		5.2 - 6.3		5.9 - 12.7	
Ammonia (N)	4.77	0.00207									4.77	0.00207
Fluoride	0.64	0.000278	2.5	0.00368	27	0.161	6.4	0.00654	47	0.0590	16.7	0.0461
Oil and Grease	504	0.219	461	0.551	114	0.681	9.1	0.00930	210	0.264	245	0.345
Phenols (4AAP)	0.439	0.000190			1.86	0.0111	0.164	0.000168	2.20	0.00276	1.17	0.00355
Total Suspended Solids	4345	1.88	18,629	27.6	558	3.33	5378	5.49	809	1.02	6110	7.86
39 Fluoranthene					0.254	0.00152	0.0	0.0	ND	ND	0.085	0.000507
65 Phenol					0.056	0.000334	0.036	0.000037	1.037	0.00130	0.376	0.000557
76 Chrysene					0.204	0.00122	0.0	0.0	ND	ND	0.068	0.000407
84 Pyrene					0.321	0.00192	0.0	0.0	0.007	0.000009	0.109	0.000643
118 Cadmium					0.049	0.000293	0.0	0.0	1.33	0.00167	0.460	0.000654
119 Chromium					0.098	0.000585	0.206	0.000210	0.013	0.000016	0.106	0.000270
120 Copper					0.473	0.00282	0.060	0.000061	0.600	0.000753	0.378	0.00121
121 Cyanide (T)	15.2	0.00659			0.0	0.0	0.077	0.000079	0.263	0.000330	3.88	0.00175
122 Lead					5.88	0.0351	0.197	0.000201	5.33	0.00669	3.80	0.0140
124 Nickel					0.022	0.000012	0.0	0.0	0.200	0.000251	0.067	0.000088
128 Zinc					0.551	0.00329	0.939	0.000959	8.67	0.0109	3.39	0.00505

---

(1) Dissolved metals are reported for this plant.

ND: Not Detected

TABLE VII-4

EFFLUENTS - SINTERING
SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES AND TOXIC POLLUTANT SURVEYS

Plant Codes	0432A	0396A		0112D(1)		0432A		0060F(2)	
	H	J		016		017		019	
Sample Point(s)	-	2		E		D+E/(B+C+D+E) F		D	
Flow, gal/ton	104	80		142		245		26.4	
C&TT		FLP, CL, CT, VF, RTP77		NL, FLP, CL, T, SL, SS, VF, RTP90		CLA, FLP, Scr, T, VF		NL, FLP, TP, RTP91	
		mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs
pH	Not Available	12.8		6.7 - 7.3		10.1 - 10.9		6.1 - 6.5	
Ammonia (N)		NA	NA	NA	NA	ISD	ISD	NA	NA
Fluoride		8.5	0.00284	24	0.0142	3.2	0.00315	32	0.00352
Oil and Grease		1.0	0.000334	96	0.0568	5	ISD	14	0.00154
Phenols (4AAP)		NA	NA	1.73	0.00102	2.86	0.000170	2.34	0.000258
Total Suspended Solids		9.2	0.00307	475	0.281	38	0.112	69	0.00760
39 Fluoranthene				0.223	0.000132	0.0	0.0	0.017	0.000002
65 Phenol				0.048	0.000028	0.630	0.000039	0.527	0.000058
76 Chrysene				0.183	0.000108	0.0	0.0	ND	ND
84 Pyrene				0.291	0.000172	0.0	0.0	0.046	0.000005
118 Cadmium				0.043	0.000025	0.0	0.0	1.33	0.000146
119 Chromium				0.090	0.000053	0.0	0.0	0.013	0.000001
120 Copper				0.467	0.000277	0.026	0.000014	0.500	0.000055
121 Cyanide (T)				0.0	0.0	1.11	0.000008	0.094	0.000010
122 Lead				5.33	0.00316	0.079	0.000004	6.00	0.000661
124 Nickel				0.003	0.000002	0.0	0.0	0.200	0.000022
128 Zinc				0.500	0.000296	0.935	0.000048	9.67	0.00106

---

(1) While the effluent from this system was the bottom flow from a moisture eliminator, the moisture eliminator recycle to the process is provided as an indication effluent quality.

(2) The metals data for this plant represent dissolved values. While the discharge from this system was the underflow from a "Lamella" separator, the "Lamella" overflow sample quality is provided in order to demonstrate the treatment capabilities of this system.

ISD: Insufficient data to complete evaluation.
ND : Not Detected
NA : No analysis performed

TABLE VII-5

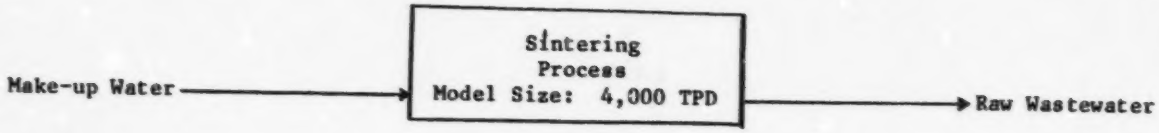
SUMMARY OF LONG-TERM EFFLUENT ANALYTICAL DATA
SINTERING

(All concentrations expressed in mg/l)

Plant Code C&TT	0112A NL, CL, VF, RTP82				0920F NC, CL, RTP and RUP-94			
	No. of Samples	**Mean**	**High**	**Standard Deviation**	**No. of Samples**	**Mean**	**High**	**Standard Deviation**
Flow, gal/min	180	1,542	2,591	540	59	24	49	12.8
pH, Units	-	-	-	-	60	8.1 to 9.3		-
Ammonia (N)	180	34.9	60	6.94	-	-	-	-
Fluoride	-	-	-	-	11	41.2	70	16.8
Oil and Grease	-	-	-	-	60	14	70	10.04
Phenols (4AAP)	180	0.06	1.24	0.12	-	-	-	-
Temperature, °C	-	-	-	-	60	31	45	8.3
Total Suspended Solids	180	38.4	158	25.35	60	56.1	149	26.75
121 Cyanide (T)	180	0.097	0.444	0.083	-	-	-	-

TABLE VII-6

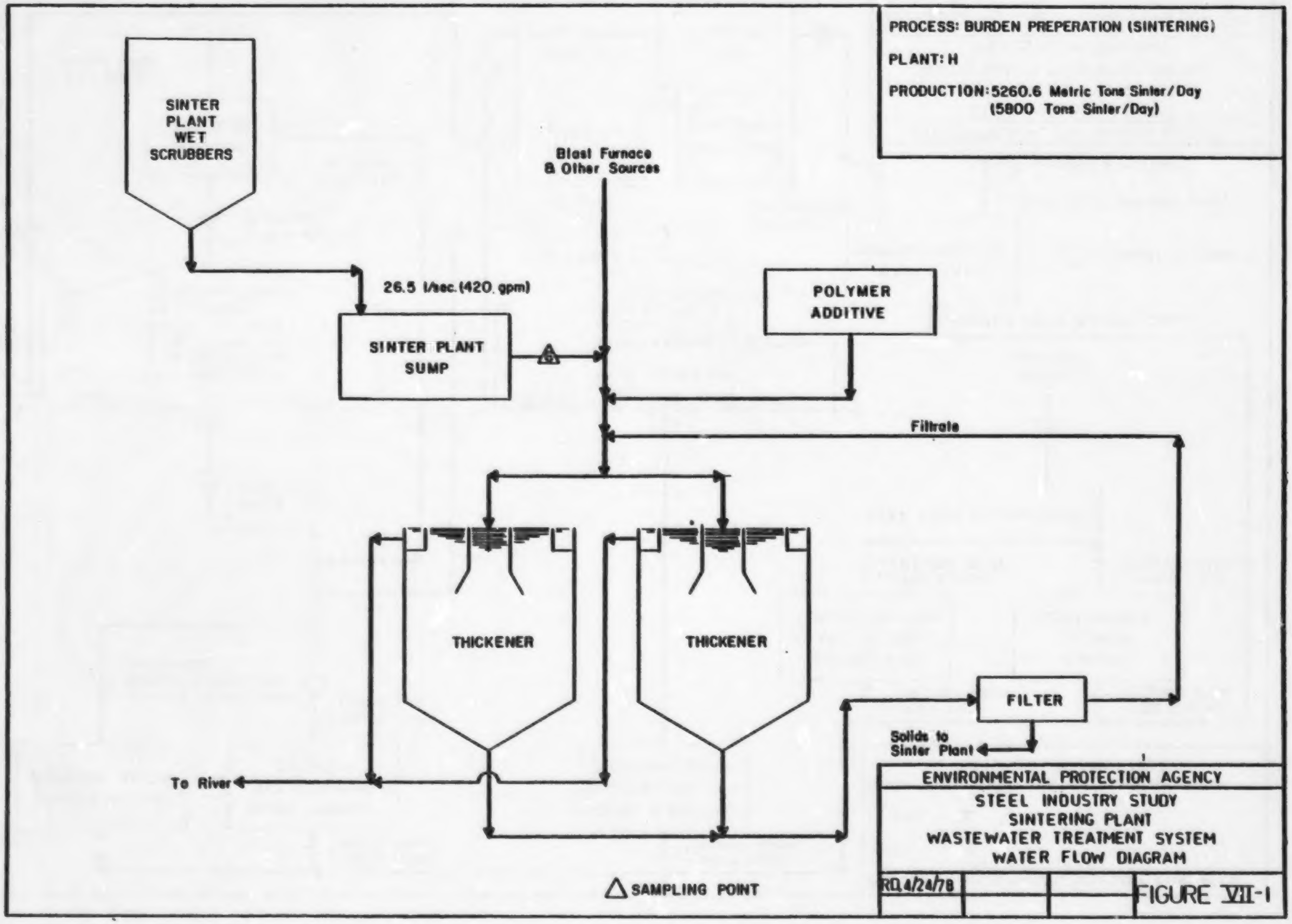
NET CONCENTRATION AND LOAD ANALYSIS
SINTERING OPERATIONS


Make-up Water
Sintering
Process
Model Size: 4,000 TPD
Raw Wastewater

120 GPT x 4,000 TPD = 480,000 GPD

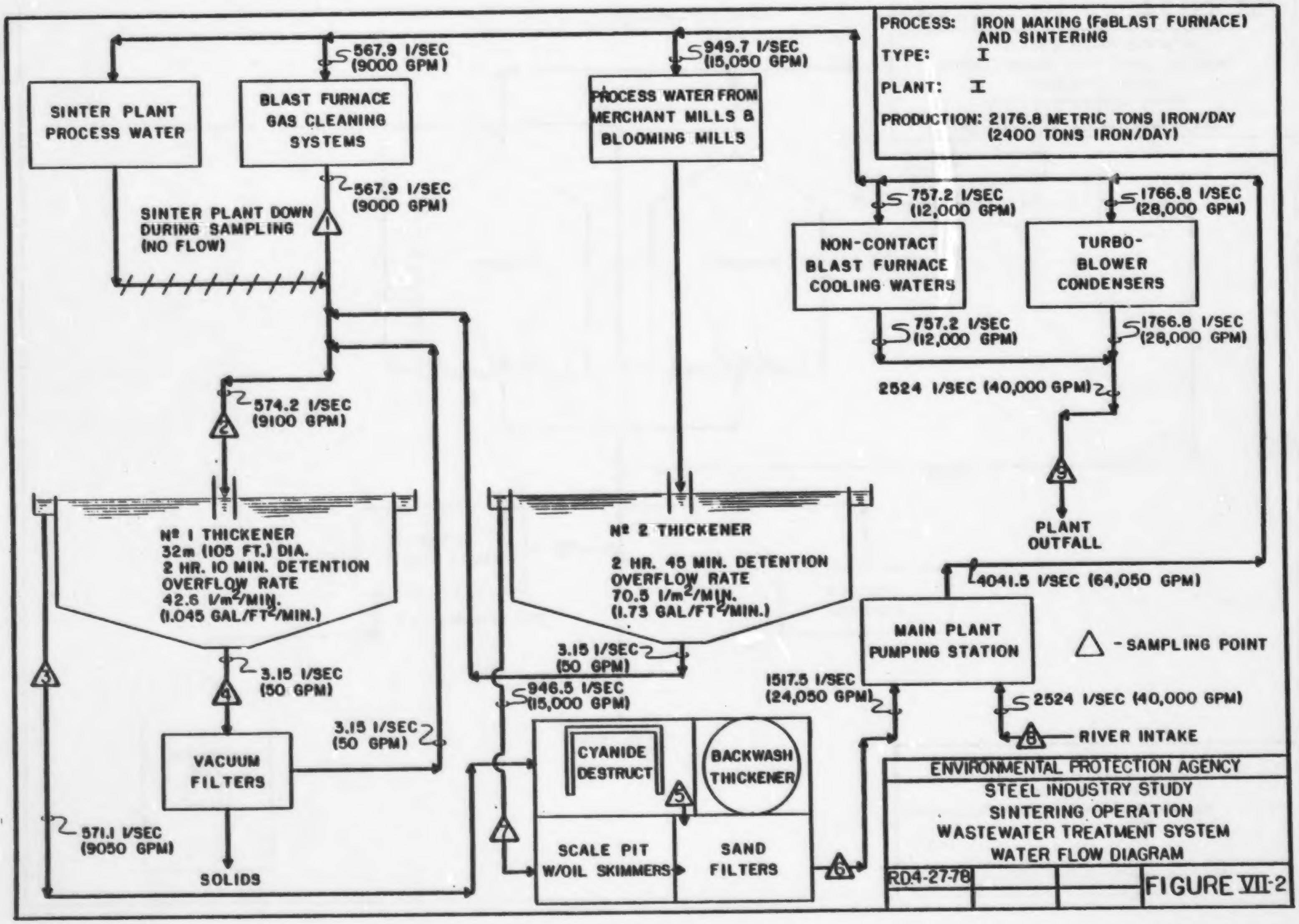
1,460 GPT x 4,000 TPD = 5.84 MGD

Regulated Pollutants	Make-up Conc. (mg/l) Min.	Make-up Conc. (mg/l) Max.	Make-up Conc. (mg/l) Avg.	Make-up Avg. Load (lbs/day)	Raw Waste Avg. Conc. (mg/l)	Raw Waste Avg. Load (lbs/day)	Make-up as a % of Raw Waste Load
Ammonia (N)	0.0	2	0.75	3.00	6	292.2	1.03
Oil & Grease	3	6	4.5	18.01	240	11,689	0.15
Phenols (4AAP)	0.001	0.149	0.044	0.18	0.2	9.74	1.85
Total Suspended Solids	<1	55	13	52.04	610.0	297,104	0.018
121 Cyanide	0.003	0.043	0.017	0.068	0.2	9.74	0.70
122 Lead	0.020	0.020	0.010	0.040	0.15	7.31	0.55
128 Zinc	<0.060	0.092	0.057	0.23	1	48.71	0.47


PROCESS: BURDEN PREPERATION (SINTERING)
PLANT: H
PRODUCTION: 5260.6 Metric Tons Sinter/Day
(5800 Tons Sinter/Day)
SINTER PLANT WET SCRUBBERS
26.5 l/sec. (420. gpm)
SINTER PLANT SUMP
5
Blast Furnace & Other Sources
POLYMER ADDITIVE
Filtrate
THICKENER
THICKENER
FILTER
Solids to Sinter Plant
To River
△ SAMPLING POINT
RD 4/24/78

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
SINTERING PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

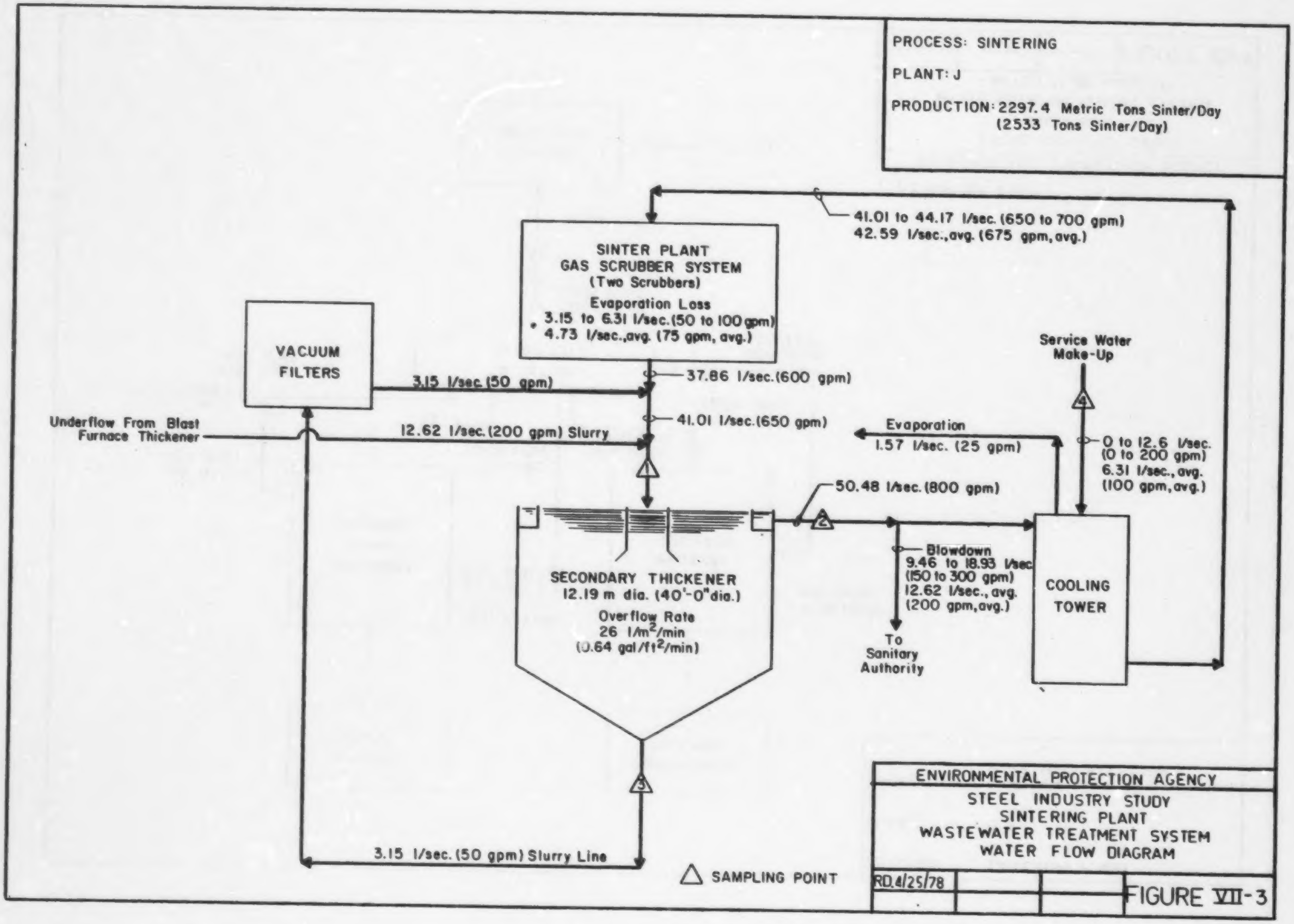
FIGURE VII-1


PROCESS: IRON MAKING (FeBLAST FURNACE) AND SINTERING
TYPE: I
PLANT: I
PRODUCTION: 2176.8 METRIC TONS IRON/DAY (2400 TONS IRON/DAY)
SINTER PLANT PROCESS WATER
BLAST FURNACE GAS CLEANING SYSTEMS
567.9 l/SEC (9000 GPM)
567.9 l/SEC (9000 GPM)
SINTER PLANT DOWN DURING SAMPLING (NO FLOW)
1
PROCESS WATER FROM MERCHANT MILLS & BLOOMING MILLS
949.7 l/SEC (15,050 GPM)
757.2 l/SEC (12,000 GPM)
NON-CONTACT BLAST FURNACE COOLING WATERS
757.2 l/SEC (12,000 GPM)
1766.8 l/SEC (28,000 GPM)
TURBO-BLOWER CONDENSERS
1766.8 l/SEC (28,000 GPM)
2524 l/SEC (40,000 GPM)
9
PLANT OUTFALL
574.2 l/SEC (9100 GPM)
2
Nº 1 THICKENER
32m (105 FT.) DIA.
2 HR. 10 MIN. DETENTION
OVERFLOW RATE
42.6 l/m²/MIN.
(1.045 GAL/FT²/MIN.)
Nº 2 THICKENER
2 HR. 45 MIN. DETENTION
OVERFLOW RATE
70.5 l/m²/MIN.
(1.73 GAL/FT²/MIN.)
3.15 l/SEC (50 GPM)
946.5 l/SEC (15,000 GPM)
3
3.15 l/SEC (50 GPM)
4
3.15 l/SEC (50 GPM)
VACUUM FILTERS
571.1 l/SEC (9050 GPM)
SOLIDS
7
CYANIDE DESTRUCT
5
BACKWASH THICKENER
SCALE PIT W/OIL SKIMMERS
SAND FILTERS
6
1517.5 l/SEC (24,050 GPM)
MAIN PLANT PUMPING STATION
4041.5 l/SEC (64,050 GPM)
△ - SAMPLING POINT
2524 l/SEC (40,000 GPM)
8
RIVER INTAKE

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
SINTERING OPERATION
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

RD4-27-78

FIGURE VII-2


VACUUM FILTERS
SINTER PLANT GAS SCRUBBER SYSTEM (Two Scrubbers)
Evaporation Loss
3.15 to 6.31 l/sec. (50 to 100 gpm)
4.73 l/sec., avg. (75 gpm, avg.)
41.01 to 44.17 l/sec. (650 to 700 gpm)
42.59 l/sec., avg. (675 gpm, avg.)
3.15 l/sec. (50 gpm)
37.86 l/sec. (600 gpm)
41.01 l/sec. (650 gpm)
Underflow From Blast Furnace Thickener
12.62 l/sec. (200 gpm) Slurry
1
SECONDARY THICKENER
12.19 m dia. (40'-0" dia.)
Overflow Rate
26 l/m²/min
(0.64 gal/ft²/min)
2
50.48 l/sec. (800 gpm)
Evaporation
1.57 l/sec. (25 gpm)
Service Water Make-Up
4
0 to 12.6 l/sec. (0 to 200 gpm)
6.31 l/sec., avg. (100 gpm, avg.)
Blowdown
9.46 to 18.93 l/sec (150 to 300 gpm)
12.62 l/sec., avg. (200 gpm, avg.)
To Sanitary Authority
COOLING TOWER
3
3.15 l/sec. (50 gpm) Slurry Line
△ SAMPLING POINT
RD. 4/25/78

PROCESS: SINTERING

PLANT: J

PRODUCTION: 2297.4 Metric Tons Sinter/Day
(2533 Tons Sinter/Day)

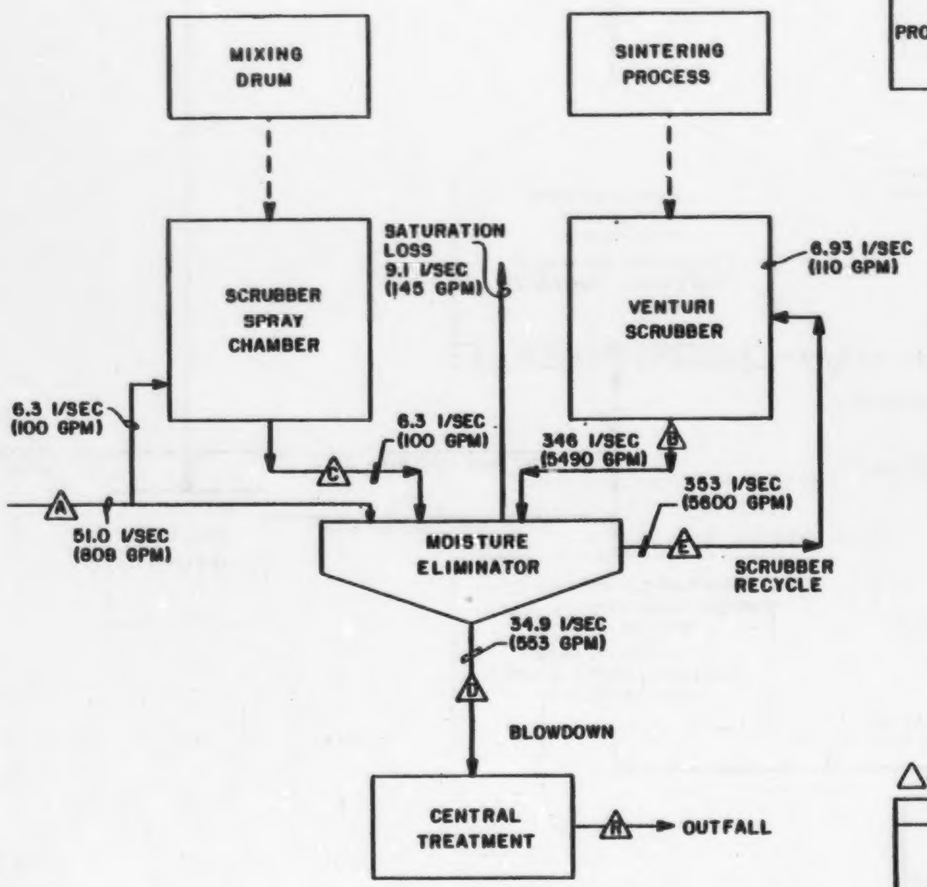
ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
SINTERING PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-3

PROCESS: SINTERING PLANT

PLANT: 016

PRODUCTION: 5100 METRIC TONS STEEL/DAY
(5622 TONS STEEL/DAY)

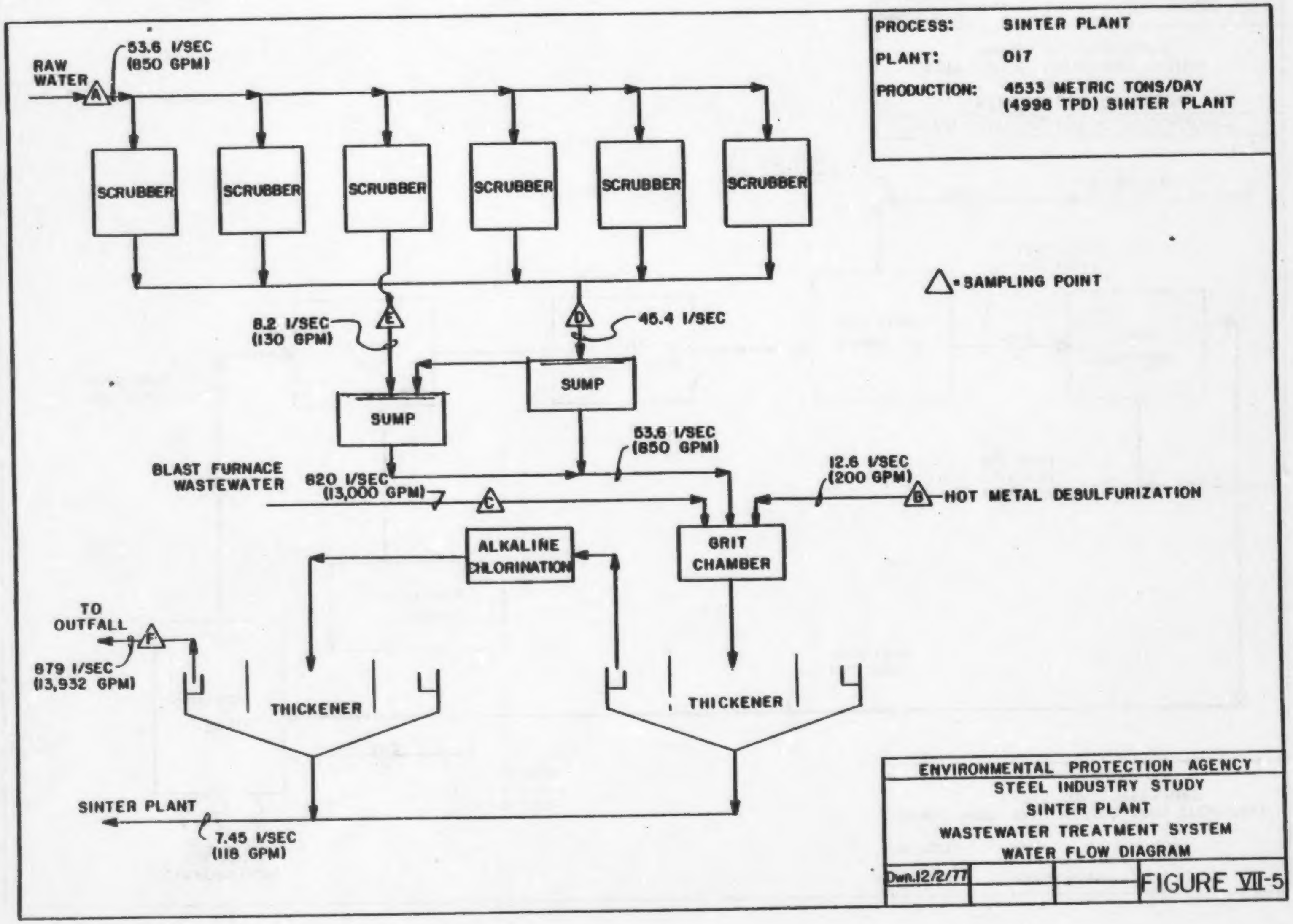

MIXING DRUM
SINTERING PROCESS
SCRUBBER SPRAY CHAMBER
VENTURI SCRUBBER
SATURATION LOSS
9.1 l/SEC
(145 GPM)
6.93 l/SEC
(110 GPM)
6.3 l/SEC
(100 GPM)
6.3 l/SEC
(100 GPM)
346 l/SEC
(5490 GPM)
353 l/SEC
(5600 GPM)
A
B
C
D
E
H
51.0 l/SEC
(808 GPM)
MOISTURE ELIMINATOR
SCRUBBER RECYCLE
34.9 l/SEC
(553 GPM)
BLOWDOWN
CENTRAL TREATMENT
OUTFALL

△ - SAMPLING POINT

ENVIRONMENTAL PROTECTION AGENCY

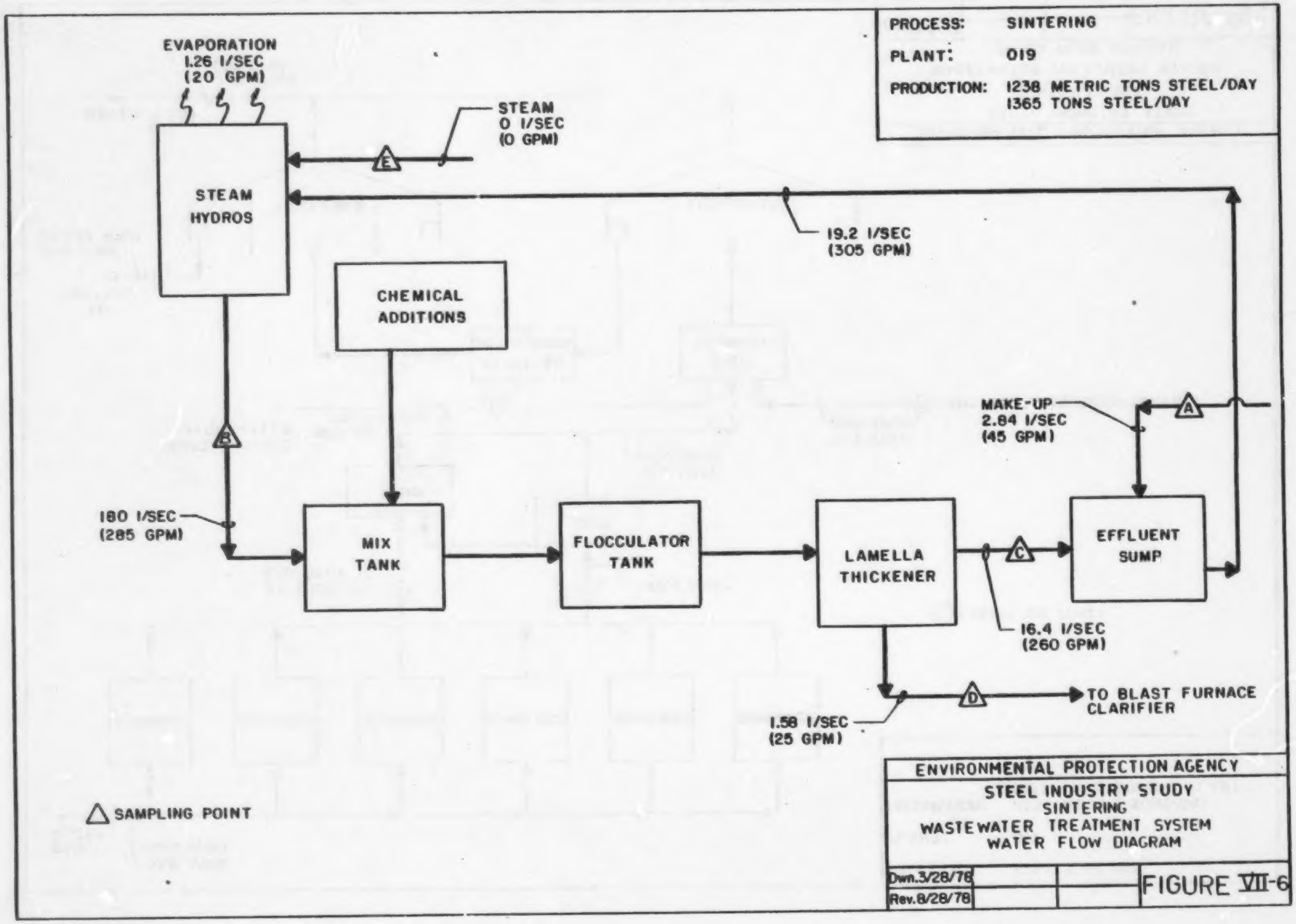
STEEL INDUSTRY STUDY
SINTERING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-4


PROCESS: SINTER PLANT
PLANT: 017
PRODUCTION: 4533 METRIC TONS/DAY (4998 TPD) SINTER PLANT
RAW WATER
A
53.6 l/SEC (850 GPM)
SCRUBBER
SCRUBBER
SCRUBBER
SCRUBBER
SCRUBBER
SCRUBBER
△ = SAMPLING POINT
E
8.2 l/SEC (130 GPM)
D
45.4 l/SEC
SUMP
SUMP
53.6 l/SEC (850 GPM)
BLAST FURNACE WASTEWATER
820 l/SEC (13,000 GPM)
C
12.6 l/SEC (200 GPM)
B
HOT METAL DESULFURIZATION
ALKALINE CHLORINATION
GRIT CHAMBER
TO OUTFALL
F
879 l/SEC (13,932 GPM)
THICKENER
THICKENER
SINTER PLANT
7.45 l/SEC (118 GPM)
Dwn.12/2/77

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
SINTER PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-5


EVAPORATION
1.26 l/SEC
(20 GPM)
STEAM
0 l/SEC
(0 GPM)
E
STEAM HYDROS
19.2 l/SEC
(305 GPM)
CHEMICAL ADDITIONS
B
180 l/SEC
(285 GPM)
MIX TANK
FLOCCULATOR TANK
LAMELLA THICKENER
MAKE-UP
2.84 l/SEC
(45 GPM)
A
C
EFFLUENT SUMP
16.4 l/SEC
(260 GPM)
1.58 l/SEC
(25 GPM)
D
TO BLAST FURNACE CLARIFIER
△ SAMPLING POINT

PROCESS: SINTERING
PLANT: 019
PRODUCTION: 1238 METRIC TONS STEEL/DAY
1365 TONS STEEL/DAY

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
SINTERING
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

Dwn.3/28/78
Rev.8/28/78

FIGURE VII-6

SINTERING SUBCATEGORY

SECTION VIII

COST, ENERGY, AND NON-WATER QUALITY IMPACTS

Introduction

This section presents the model treatment systems and industry-wide costs for the model treatment systems described in Sections IX through XIII. The analysis presented in this section includes the costs associated with the application of the various technologies, and a consideration of energy requirements and non-water quality impacts (i.e., solid waste generation rates, air pollution impacts, and the consumptive use of water).

Actual Costs Incurred by the Plants Sampled or Solicited for This Study

Water pollution control costs supplied by the industry for sintering operations surveyed during this study or included in D-DCP responses are presented in Table VIII-1. These costs have been equated to July 1978 dollars from the actual cost and year(s) of expenditure(s) data supplied by each of these plants.

The Agency compared the capital cost data reported for several plants to its capital cost estimates. This comparison was made to determine whether the Agency's estimated treatment model costs are sufficient to cover the industry's actual costs, including site-specific and other incidental costs. Following is a tabulation of the actual capital costs reported by the industry (refer to Table VIII-1) and EPA estimated costs factored from the model cost:

Plant No.	Actual Cost ($)	Estimated Cost ($)
0060	733,550	1,808,700
0396A	832,000	3,134,300
0856F	511,020	2,248,800
0864A	1,731,048	1,334,300
0920F	2,626,000	1,987,900
TOTAL	6,433,818	10,533,100
0112A	1,206,430	6,991,100

The above cost data are for facilities in-place as of January 1, 1978. The large difference between the actual and estimated costs for plant 0112A is due to substantial differences in production capacity and flow between this plant and the treatment model. On this basis, the costs for Plant 0112A were not included in the totals. While actual costs were also reported for Plant 0432A, which has a central treatment system for blast furnace and sintering wastewaters, a determination of those costs attributable to sintering wastewater treatment could not be made because the sinter plant flow is small in relation to the total central treatment system flow.

Referring to the costs for the remaining five plants, actual costs for two of the plants are greater than the estimated costs and three of the estimated costs are higher. The most noteworthy observation, however, is the comparison of the total costs, as this more closely reflects on the appropriateness of using model costs to estimate subcategory-wide costs. As the reported costs are about 34% less than the Agency's estimated costs, the estimated costs compare favorably in two ways. First, the Agency's total cost estimate is sufficiently generous to account for the various site-specific and other incidental costs associated with industry's compliance with the limitations. Second, the Agency's total cost estimate is not excessively generous and thus provides a fair indication of the cost of treatment to the industry.

Control and Treatment Technologies (C&TT)
Recommended for Use in the Sintering Subcategory

The components of the BPT and BAT model treatment systems are presented in Table VIII-2. It should be noted that the regulation does not require the installation of the model treatment system, as any treatment arrangement which achieves the effluent limitations and standards is adequate. Table VIII-2 presents information pertaining to the following items.

1. Description
2. Implementation time
3. Land requirements

Cost, Energy, and Non-Water Quality Impacts

Introduction

Compliance with the BPT and BAT limitations and the NSPS, PSES, and PSNS will require additional expenditures (both investment and operating) and additional energy consumption. This section addresses these requirements and the air pollution, water consumption and solid waste disposal impacts associated with each treatment system considered. Costs and energy requirements were estimated on the basis of the alternative treatment models developed in Sections IX through XIII of this report. Figure VIII-1 illustrates the BPT and BAT, NSPS, PSES, and PSNS alternative treatment models.

Estimated Costs for the Installation of Pollution Control Technologies

A. Costs Required to Achieve the BPT Limitations

As a first step in estimating the costs of each treatment model, the Agency developed a model system upon which cost estimates were to be based. The model size (tons/day) and applied flow rates were developed on the basis of the average production capacity and average applied flow rate for all "wet" sintering operations, respectively. Reference is made to Section IX for identification of the BPT model treatment system. Table VIII-3 presents the model treatment component capital and annual costs. The Agency has calculated costs for facilities in-place at each "wet" sintering operation, and has estimated the costs of the model system components required to achieve the BPT limitations. On the basis of the cost comparison provided previously in this section, the Agency believes that its cost estimates are sufficient to cover site-specific and other retrofit costs.

The capital requirements for achieving the BPT limitations were determined by applying the model treatment component costs, adjusted for size, to each "wet" sintering operation. Based upon these data, the Agency estimates that as of July 1, 1981 approximately 5.1 million dollars remains to be spent for BPT facilities. The associated annual cost of operation of BPT for sintering operations is estimated to be 2.2 million dollars.

B. Costs Required to Achieve the BAT Limitations

Reference is made to Section X for a description of the five alternative treatment models considered and for the selection of the treatment model upon which the BAT limitations are based. The additional investment and annual expenditures for each of the BAT alternative treatment models are presented in Table VIII-4. The BAT costs for each "wet" sintering operation were determined by adjusting the model costs for each required component by the actual size of the plants. The subcategory-wide costs are the sums of the costs for each of the sintering of plants in the industry. The subcategory costs (July 1, 1978 dollars) for each of the BAT alternatives are as follows:

BAT	Investment Costs ($)		Annual Costs ($)	
Alternative	In-Place	Required	In-Place	Required
1	509,400	5,512,600	52,400	742,300
2	1,196,200	3,784,200	138,500	503,700
3	1,370,000	8,963,300	170,400	2,120,800
4	1,879,400	45,977,600	222,800	6,924,200
5	0	74,799,800	0	15,395,000

C. Costs Required to Achieve the BCT Limitations

BCT has been reserved at this time, since the BCT cost methodology was remanded by the Fourth Circuit Court. A new methodology is currently under development in the Agency.

D. Costs Required to Achieve NSPS

The Agency considered five treatment alternatives as model NSPS treatment systems. The NSPS treatment systems are similar to the BPT/BAT treatment systems, however, the model size has been increased in recognition of the trend toward larger new source sintering operations. The NSPS model treatment system size is based upon the average production capacity of those facilities which began operation in the last decade. The capital and annual costs for the NSPS alternative treatment systems are presented in Table VIII-5. Refer to Section XII for discussions of the treatment models and the selection of the model upon which the NSPS are based. Since this study did not include projections of industry capacity additions, industry-wide new source costs are not presented here.

E. Costs Required to Achieve PSES and PSNS

Pretreatment standards apply to those existing and new sources which currently or may discharge wastewaters to POTWs. The six alternative pretreatment systems are similar to the BPT and alternative BAT model treatment systems. The model size for pretreatment standards for existing sources (PSES) is the same as that of the BPT and BAT treatment models, while the model size for pretreatment standards for new sources (PSNS) is the same as that of the NSPS treatment models. Reference is made to Section XIII for identification of the model PSES/PSNS treatment systems and for selection of the model system upon which the PSES and PSNS are based. PSES model costs are identical to the BPT and the BPT plus respective BAT alternative model costs (Table VIII-4). The PSNS model treatment component costs are identical to the NSPS model treatment costs presented in Table VIII-5. The Agency estimates that 0.36 million dollars remains to be spent for PSES facilities and that PSES annual costs of operation are 1.33 million dollars.

Energy Impacts

Moderate amounts of energy will be required for the BPT model and BAT, NSPS, PSES, and PSNS alternative treatment systems for the sintering subcategory. The major energy expenditures occur at BPT, while the selected BAT model treatment system requires relatively minor additional energy expenditures. This relationship reflects the high recycle rate in the BPT model treatment system. Energy requirements for PSES will approximate the corresponding BPT and BAT systems, while the requirements for NSPS and PSNS will be slightly greater than those for the corresponding BPT and BAT system.

A. Energy Impacts at BPT

The Agency estimated the energy requirements for this subcategory based upon the assumption that all "wet" sintering operations will install treatment systems similar to that of the model treatment system with flows similar to that of the model. On this basis, the energy requirement for BPT for all active "wet" sintering operations is 40.2 million kilowatt hours of electricity per year. This estimate represents about 0.07% of the 57 billion kilowatt hours of electricity used by the steel industry in 1978.

B. Energy Impacts at BAT

The estimated energy requirements for the BAT alternative treatment systems are based upon the same assumptions noted above for BPT. The estimated energy requirements at each alternative treatment level for all active "wet" sintering operations, and the relationship to 1978 industry power consumption, follows:

BAT Alternative	kwh per Year	% of Industry Usage
1	2.28 million	0.004
2	1.20 million	0.002
3	4.26 million	0.007
4	11.46 million	0.020
5	239.6 million	0.42

The Agency considers the requirements of the selected alternative (No.1) to be justified in light of the total industry usage and the effluent reduction benefits obtained.

C. Energy Impacts at NSPS and Pretreatment

The estimated PSES energy requirement at each alternative treatment level, and the relationship to the industry's 1978 power consumption, are as follows:

Model	kwh/Year	% of Industry Usage
PSES-1	2.48 million	0.0044
PSES-2	2.64 million	0.0046
PSES-3	2.56 million	0.0045
PSES-4	2.72 million	0.0048
PSES-5	3.20 million	0.0056
PSES-6	18.46 million	0.032

Following are the estimated model energy requirements for each NSPS and PSNS alternative treatment system. Estimates of the total energy impact of NSPS and PSNS are not included, since projections of capacity additions were not included as part of this study.

Model	kwh/Year
PSNS-1	4.77 million
PSNS-2	5.00 million
PSNS-3	4.88 million
PSNS-4	5.10 million
PSNS-5	5.65 million
PSNS-6	30.90 million
NSPS-1	5.06 million
NSPS-2	4.95 million
NSPS-3	5.16 million
NSPS-4	5.72 million
NSPS-5	30.90 million

The estimated energy requirements for the model NSPS and PSNS alternative treatment systems are greater than the corresponding BPT and BAT alternative totals because of model size differences.

Non-Water Quality Impacts

In general, the Agency has concluded that non-water quality impacts associated with the model treatment technologies will be minimal. The impacts of these technologies on air pollution, solid waste disposal, and water consumption are presented below.

A. Air Pollution

The use of alkaline chlorination in conjunction with BAT and NSPS Alternatives 3 and 4, (PSES/PSNS alternatives 4 and 5) may result in the localized atmospheric discharge of chlorine. However, since the chlorine is added directly to the wastewater and reacts rapidly with the constituents in the wastewater, only negligible amounts would be emitted to the atmosphere. In these same alternatives, proper operating practices and procedures would greatly reduce or eliminate potential air pollution problems associated with the use of dechlorination agents (e.g., sulfur dioxide).

In addition to the above atmospheric discharges, regeneration of spent activated carbon from BAT and NSPS Alternative 4 (PSES/PSNS Alternative 5) may also result in the atmospheric discharge of various pollutants. However, the regeneration temperatures are sufficiently high to oxidize most organic pollutants.

In view of these observations, the Agency does not consider the impacts of air pollution to be significant.

B. Solid Waste Disposal

The BPT model treatment system will generate significant quantities of solid wastes which require disposal. BAT alternatives are minimal and are included with those for BPT. The Agency estimates that compliance with the BPT and BAT limitations will result in the generation of 2,655,000 tons/year of solid wastes. BAT accounts for less than 1% of this total. The solid wastes generated at PSES amount to 165,940 tons/year.

As with BPT and BAT, the incremental solid waste generation rates for PSES/PSNS alternatives 2-6 and NSPS alternatives 2-5 are minimal over those of the respective first alternatives. The solid waste generation rate is 290,400 tons/year for the PSNS and NSPS treatment models.

C. Water Consumption

Evaporative cooling is not included as a treatment step in this subcategory, and those treatment steps which are included are essentially not water consumptive. As a result, there are no impacts due to water consumption at the BPT, BAT, NSPS, PSES and PSNS levels of treatment.

Summary of Impacts

In summary, the Agency concludes that the pollutant load reduction benefits described below for the sintering subcategory outweigh the adverse energy and non-water quality environmental impacts:

DIRECT DISCHARGERS

Pollutant Loadings (tons/year)

	Raw Waste	BPT	BAT
Flow (MGD)	93.4	7.2	7.2
Ammonia(N)	853.8	65.8	65.8
Cyanide(T)	28.5	2.2	2.2
Fluoride	853.8	274.1	219.3
Oil and Grease	34,153.3	76.8	38.4
Phenols(4AAP)	28.5	2.2	2.2
TSS	868,064.2	427.6	109.7
Total Toxic Metals	298.8	14.0	4.8
Total Toxic Organics*	17.1	1.3	1.3

* Toxic organics does not include the individual phenolic compounds.

INDIRECT (POTW) DISCHARGERS
Pollutant Loadings (tons/year)

	Raw Waste	PSES
Flow(MGD)	5.8	0.5
Ammonia(N)	53.4	4.4
Cyanide(T)	1.8	0.1
Fluoride	53.4	14.6
Oil and Grease	2,134.6	2.6
Phenols(4AAP)	1.8	0.1
TSS	54,254.0	7.3
Total Toxic Metals	18.7	0.3
Total Toxic Organics*	1.1	0.1

* Toxic organics does not include the individual phenolic compounds.

The Agency also concludes that the effluent reduction benefits associated with compliance with new source standards (NSPS, PSNS) outweigh the adverse energy and non-water quality environmental impacts.

TABLE VIII-1

EFFLUENT TREATMENT COSTS
SINTERING

(All costs are expressed in July 1978 Dollars)

Plant Code Reference No.	J 0396A	016 0112D	017 0432A	0060	0112A	0856F	0864A	0920F
Initial Investment Cost	$832,000	(3)	$560,050(4)	$733,550	$1,206,430	$511,020	$1,731,040	$2,626,200
Capital	$74,797(1)		$50,348(1)	$65,946(1)		$45,941(1)	$155,620(1)	$236,095(1)
Cost of Capital					$91,568(6)			
Depreciation					67,024(6)			
Operation & Maintenance			24,643(5)				254,169	
Energy, Power, Chemicals, etc.	29,120(2)		3,044(5)	25,674(2)	42,225(7)	17,886(2)	102,626	91,917(2)
TOTAL	$103,917		$77,395	$91,620	$200,817	$63,827	$512,415	$328,012
$/Ton(8)	0.112		0.044	0.154	0.068	0.029	0.632	0.928

Note: No cost data were provided for plants H, I, K, and 019.

(1) The capital is based on the formula, Initial Investment x 0.0899
(2) Combined O&M cost is based on the formula, Initial Investment x 0.035.
(3) Costs reported in plant visit log include both air and water treatment costs and as such cannot be used in this table.
(4) Combined treatment cost over a number of years was only cost supplied. Based on a review of installation dates as provided in the 308, the following apportionment was devised: 75% of the total cost in 1951 and 25% in 1971. The cost contributed by sintering was based on the proportion of sintering flow (850 gpm) to total flow (14,400 gpm).
(5) Based on the flow proportions discussed in item (4).
(6) Company based cost of capital and depreciation amounts.
(7) Operating costs are based on formula in (2) because costs supplied include operating expense of air pollution control equipment.
(8) Tonnage is based on plant visit or D-DCP data.

NA: Not Available

TABLE VIII-2

CONTROL AND TREATMENT TECHNOLOGIES SINTERING SUBCATEGORY

C&TT Step	Description	Implementation Time (months)	Land Usage (ft^2)
A	THICKENER - Provides suspended solids removal as a result of sedimentation. Free oils and greases are removed by skimming. This step also achieves significant reductions in the levels and loads of those metals which are in the particulate form.	15 to 18	20,000
B	FLOCCULATION WITH POLYMER - This step enhances suspended solids and particulate pollutant removal performance in Step A.	6	625
C	VACUUM FILTER - Vacuum filters are used to dewater the sludges removed from the sedimentation steps. The filtrate is returned to the treatment system influent.	15 to 18	20,000
D	RECYCLE - Ninety-two percent of the thickener effluent is returned to the process. This serves to reduce the pollutant load discharged from the process.	12 to 14	625
E	NEUTRALIZATION WITH ACID - The pH of the BPT treatment system effluent is monitored and adjusted as necessary to assure that the treated effluent pH is within the neutral range.	8 to 10	625
F	PRESSURE FILTRATION - Filters provide additional suspended solids and particulate pollutant removal.	15 to 18	625
G	NEUTRALIZATION WITH ACID - This is a BPT treatment system model C&TT step which is relocated for use in BAT Alternative Nos. 1 and 2.	-	-
H	FLOCCULATION WITH LIME - Lime is added in order to provide additional toxic metals removal.	12	625

TABLE VIII-2
CONTROL AND TREATMENT TECHNOLOGIES
SINTERING SUBCATEGORY
PAGE 2

C&TT Step	Description	Implementation Time (months)	Land Usage (ft^2)
I	INCLINED PLATE SEPARATOR - This component provides additional suspended solids and particulate pollutant removal.	10 to 12	245
J	TWO-STAGE CHLORINATION - This C&TT is provided cyanide destruction and to oxidize phenols and ammonia. The basic pro-cesses include: lime addition; first stage chlorine addition; first stage reaction period; acid addition; second stage chlorine addition; and second stage reaction period.	12 to 15	2500
K	SULFUR DIOXIDE ADDITION - The reducing agent sulfur dioxide is added to the Step J effluent in order to reduce essentially all residual chlorine resulting from Step J.	8 to 10	625
L	ACTIVATED CARBON ADSORPTION - Prior to discharge, the treated wastewaters (the filter effluent) in BAT Alternative No. 4 are passed through a column of granular activated carbon in order to remove residual levels of toxic organic pollutants. This removal is achieved by adsorption on the activated carbon.	15 to 18	625
M	EVAPORATION - The effluent from the BPT treatment system model is delivered to a vapor decompression evaporation system. This system produces a distillate quality effluent and crystalline solids.	18 to 20	1000
N	RECYCLE - The effluent of Step M is returned to the process as a makeup water supply.	12 to 14	625

TABLE VIII-3

BPT TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory : Sintering

Model Size-TPD : 4,000
Oper. Days/Year: 365
Turns/Day : 3

C&TT Step	A	B	C	D	E	Total
Investment ($ x 10^{-3})	1,580.5	34.4	1,294.2	601.0	105.0	3,615.1
Annual Costs ($ x 10^{-3})						
Capital	142.1	3.1	116.3	54.0	9.4	324.9
Operation & Maintenance	55.3	1.2	45.3	21.0	3.7	126.5
Land	0.9		1.1	0.1	0.1	2.2
Sludge Disposal			829.7			829.7
Hazardous Waste Disposal						
Oil Disposal						
Energy & Power	3.3	1.6	57.2		0.7	62.8
Steam						
Waste Acid						
Crystal Disposal						
Chemical		64.4			19.7	84.1
TOTAL	201.6	70.3	1,049.6	75.1	33.6	1,430.2
Credits						
Scale						
Sinter						
Oil						
Acid Recovery						
TOTAL CREDITS						
NET TOTAL	201.6	70.3	1,049.6	75.1	33.6	1,430.2

KEY TO C&TT STEPS

A: Thickening
B: Flocculation with Polymer
C: Vacuum Filtration
D: Recycle
E: Neutralization with Acid

TABLE VIII-4

BAT/PSES TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Sintering

Model Size - TPD: 4,000
Oper. Days/Year : 365
Turns/Day : 3

C&TT Step	Total	BAT Alternative 1			BAT Alternative 2				BAT Alternative 3				BAT Alternative 4 Alt. 3 Plus:			BAT Alternative 5		
	BPT	F	G*	Total	G*	H	I	Total	I	J	K	Total	F	L	Total	M	N	Total
Investment ($ x 10^{-3})	3,615.1	401.0	0.0	401.0	0.0	79.9	236.0	315.9	236.0	322.3	88.8	647.1	401.0	2,079.0	3,127.1	4,664.6	271.9	4,936.5
Annual Costs ($ x 10^{-3})																		
Capital	324.9	36.1		36.1		7.2	21.2	28.4	21.2	29.0	8.0	58.2	36.1	186.9	281.2	419.3	24.4	443.7
Operation & Maintenance	126.5	14.0		14.0		2.8	8.3	11.1	8.3	11.3	3.1	22.7	14.0	72.8	109.5	163.3	9.5	172.8
Land	2.2	0.1		0.1		0.1	0.1	0.2	0.1	0.2	0.1	0.4	0.1	0.1	0.6	0.1	0.1	0.2
Sludge Disposal	829.7																	
Hazardous Waste Disposal																		
Oil Disposal																		
Energy & Power	62.8	3.8		3.8		1.0	1.0	2.0	1.0	5.0	1.1	7.1	3.8	8.2	19.1	399.3		399.3
Steam																		
Waste Acid																		
Crystal Disposal																		
Chemical	84.1									59.5	3.3	62.8			62.8			
TOTAL	1,430.2	54.0	0.0	54.0	0.0	11.8	30.6	42.4	30.6	105.0	15.6	151.2	54.0	268.0	473.2	982.0	34.0	1,016.0
Credits																		
Scale																		
Sinter																		
Oil																		
Acid Recovery																		
TOTAL CREDITS																		
NET TOTAL	1,430.2	54.0	0.0	54.0	0.0	11.8	30.6	42.4	30.6	105.0	15.6	151.2	54.0	268.0	473.2	982.0	34.0	1,016.0

KEY TO TREATMENT ALTERNATIVES

PSES-1 = BPT*
PSES-2 = BPT* + BAT-1
PSES-3 = BPT* + BAT-2
PSES-4 = BPT* + BAT-3
PSES-5 = BPT* + BAT-4
PSES-6 = BPT* + BAT-5

KEY TO C&TT STEPS

F: Pressure Filtration
G: Neutralization with Acid
H: Flocculation with Lime
I: Inclined Plate Separation
J: 2-Stage Chlorination
K: Dechlorination
L: Granular Activated Carbon Adsorption
M: Vapor Compression Distillation
N: Recycle

Note: Component K, dechlorination, is not included in PSES-4 or 5.

* pH control is transferred from BPT for incorporation into BAT.
This treatment component is not included in the Model Costs for POTW dischargers.

TABLE VIII-5

PSNS/NSPS TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Sintering

Model Size - TPD: 7,000
Oper. Days/Year : 365
Turns/Day : 3

	PSNS Alternative 1						PSNS Alternative 2 Components A, B, C, D Plus:			PSNS Alternative 3 Components Alt. 3 Plus:			
C&TT Step	A	B	C	D	F*	Total	E	F*	Total	G	H	F*	Total
Investment ($ x 10^{-3})	2,271.1	66.8	1,511.6	893.0	80.0	4,822.5	539.3	80.0	5,361.8	109.8	286.3	80.0	5,218.6
Annual Costs ($ x 10^{-3})													
Capital	204.2	6.0	135.9	80.3	7.2	433.6	48.5	7.2	482.1	9.9	25.7	7.2	469.2
Operation & Maintenance	79.5	2.3	52.9	31.3	2.8	168.8	18.9	2.8	187.7	3.8	10.0	2.8	182.6
Land	1.5		2.0	0.1	0.1	3.7	0.1	0.1	3.8	0.1	0.1	0.1	3.9
Sludge Disposal			1,452.0			1,452.0			1,452.0				1,452.0
Hazardous Waste Disposal													0
Oil Disposal													0
Energy & Power	3.3	1.6	114.3		1.6	120.8	5.7	1.6	126.5	1.3	1.6	1.6	123.7
Steam													0
Waste Acid													0
Crystal Disposal													0
Chemical		112.3			7.5	119.8		7.5	119.8	1.3		7.5	121.1
TOTAL	288.5	122.2	1,757.1	111.7	19.2	2,298.7	73.2	19.2	2,371.9	16.4	37.4	19.2	2,352.5
Credits													
Scale													
Sinter													
Oil													
Acid Recovery													
TOTAL CREDITS													
NET TOTAL	288.5	122.2	1,757.1	111.7	19.2	2,298.7	73.2	19.2	2,371.9	16.4	37.4	19.2	2,352.5

TABLE VIII-5
PSNS/NSPS TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS
PAGE 2

	PSNS Alternative 4 Components A, B, C, D Plus:				PSNS Alternative 5 Components A, B, C, D Plus:						PSNS Alternative 6 Components A, B, C, D Plus:		
C&TT Step	H	I	J	Total	H	I	J	E	K	Total	L	M	Total
Investment ($ x 10^{-3})	286.3	442.8	122.0	5,593.6	286.3	442.8	122.0	539.3	2,391.1	8,524.0	6,407.9	308.5	11,458.9
Annual Costs ($ x 10^{-3})													
Capital	25.7	39.8	11.0	502.9	25.7	39.8	11.0	48.5	215.0	766.4	576.1	27.7	1,030.2
Operation & Maintenance	10.0	15.5	4.3	195.8	10.0	15.5	4.3	18.9	83.7	298.4	224.3	10.8	401.1
Land	0.1	0.2	0.1	4.0	0.1	0.2	0.1	0.1	0.1	4.2	0.1	0.1	3.8
Sludge Disposal				1,452.0						1,452.0			1,452.0
Hazardous Waste Disposal				0						0			0
Oil Disposal				0						0			0
Energy & Power	1.6	6.6	1.6	129.0	1.6	6.6	1.6	5.7	8.2	142.9	653.2		772.4
Steam				0						0			0
Waste Acid				0						0			0
Crystal Disposal				0						0			0
Chemical		32.9	5.5	150.7		32.9	5.5			150.7			112.3
TOTAL	37.4	95.0	22.5	2,434.4	37.4	95.0	22.5	73.2	307.0	2,814.6	1,453.7	38.6	3,771.8
Credits													
Scale													
Sinter													
Oil													
Acid Recovery													
TOTAL CREDITS													
NET TOTAL	37.4	95.0	22.5	2,434.4	37.4	95.0	22.5	73.2	307.0	2,814.6	1,453.7	38.6	3,771.8

KEY TO TREATMENT ALTERNATIVES

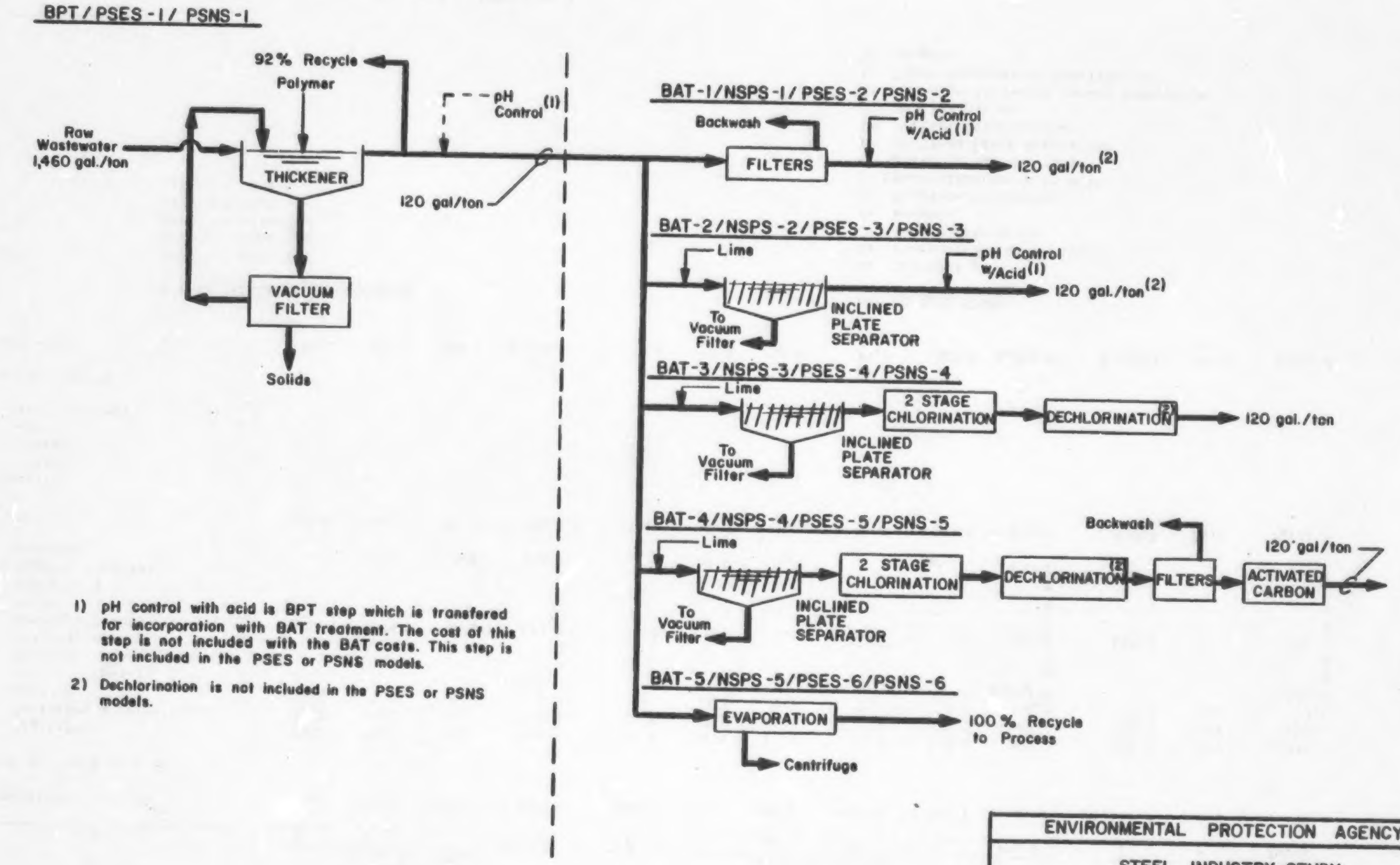
NSPS-1 = PSNS-2
NSPS-2 = PSNS-3
NSPS-3 = PSNS-4
NSPS-4 = PSNS-5
NSPS-5 = PSNS-6

KEY TO C&TT STEPS

A: Thickening
B: Flocculation with Polymer
C: Vacuum Filtration
D: Recycle
E: Pressure Filtration
F: Neutralization with Acid
G: Flocculation with Lime
H: Inclined Plate Separation
I: 2-Stage Chlorination
J: Dechlorination
K: Granular Activated Carbon Adsorption
L: Vapor Compression Distillation
M: Recycle

Note: Component J, dechlorination, is not included in PSNS-4 or 5.

* pH control is not included in the Model Costs for POTW dischargers.


BPT / PSES-1 / PSNS-1
Raw Wastewater 1,460 gal./ton
Polymer
92% Recycle
THICKENER
VACUUM FILTER
Solids
pH Control (1)
120 gal/ton
BAT-1/NSPS-1/PSES-2/PSNS-2
Backwash
FILTERS
pH Control W/Acid (1)
120 gal/ton (2)
BAT-2/NSPS-2/PSES-3/PSNS-3
Lime
INCLINED PLATE SEPARATOR
To Vacuum Filter
pH Control W/Acid (1)
120 gal./ton (2)
BAT-3/NSPS-3/PSES-4/PSNS-4
Lime
INCLINED PLATE SEPARATOR
To Vacuum Filter
2 STAGE CHLORINATION
DECHLORINATION (2)
120 gal./ton
BAT-4/NSPS-4/PSES-5/PSNS-5
Lime
INCLINED PLATE SEPARATOR
To Vacuum Filter
2 STAGE CHLORINATION
DECHLORINATION (2)
Backwash
FILTERS
ACTIVATED CARBON
120 gal/ton
BAT-5/NSPS-5/PSES-6/PSNS-6
EVAPORATION
Centrifuge
100% Recycle to Process

1) pH control with acid is BPT step which is transfered for incorporation with BAT treatment. The cost of this step is not included with the BAT costs. This step is not included in the PSES or PSNS models.

2) Dechlorination is not included in the PSES or PSNS models.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
SINTERING SUBCATEGORY
TREATMENT MODELS

Dwn. 10/20/81

FIGURE VIII - 1

SINTERING SUBCATEGORY

SECTION IX

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE

The Agency has promulgated effluent limitations for Best Practicable Control Technology Currently Available (BPT) different than those originally promulgated in June 1974[1] for sintering operations. Based upon the changes in the model treatment system flow rate, these limitations are also less stringent than those proposed on January 7, 1981 (46 FR 1858). The limitations have been adjusted to accommodate all sintering wastewater sources. The limitations promulgated in 1974 did not take into account wastewaters from raw material handling air pollution control systems. As the June 1974 development document[2] described the basic methods used in developing the previous effluent limitations, the intent of this section is to provide substantiation of the BPT effluent limitations. A review of the treatment processes and effluent limitations associated with the sintering subcategory follows.

Identification of BPT

The Agency used the original 1974 BPT model treatment system as the model treatment system for the BPT limitations, (See Figure IX-1). Suspended solids are removed from process wastewaters by gravity sedimentation in a thickener. A polymeric flocculant is added to the thickener influent to optimize the removal of suspended solids. The thickener underflow is dewatered in a vacuum filter, and the filtrate returned to the thickener inlet. About 92% of the thickener overflow is returned to the sintering operation. The pH of the treatment system blowdown, which is typically alkaline, is adjusted to the neutral pH range with acid. Oils and greases are removed by surface skimming in the thickener and also by entrainment within the solids which settle in the thickener.

As noted previously, the BPT limitations do not require the installation of the model treatment system. Any treatment system which achieves compliance with the BPT limitations is appropriate.

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[1] Federal Register; Friday, June 28, 1974; Part II, Environmental Protection Agency; Iron and Steel Manufacturing Point Source Category; Effluent Guidelines and Standards; Pages 24114-24133.

[2] EPA 440/I-74-024-a, Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Steel Making Segment of the Iron and Steel Manufacturing Point Source Category.

The BPT limitations are based upon the same effluent concentrations used in developing the originally promulgated limitations and the limitations proposed on January 7, 1981. These concentrations are well demonstrated as shown by the data in Table A-6 of Appendix A, Volume I. However, information received during the comment period indicates the model effluent flow should be increased from 417 l/kkg (100 gal/ton) to 499 l/kkg (120 gal/ton). As the model effluent flow has been increased, the effluent limitations were also increased proportionately. The BPT effluent limitations are presented below:

	kg/kkg of Product (lb/1000 lb of Product)	
	Daily Maximum Limitations	30-Day Average Limitations
Total Suspended Solids	0.0751	0.0250
Oil and Grease	0.0150	0.00501
pH (Units)	6.0 to 9.0	

Rationale for BPT

Treatment System

As noted in Section VII, the components of the BPT model treatment system are presently in use at most sintering operations.

Model Discharge Flow

Table IX-1 presents a summary of the flow, recycle rate, and operating data for this subcategory. The original model effluent flow was based upon data from one sintering operation which generates wastewater from only the discharge end (sinter cooling, crushing, and screening) of the process. However, since wastewater discharges originate at several points in the sintering operation (refer to Section III), the Agency increased the model effluent flow to accomodate all wastewater sources. The model flow rate of 120 gal/ton represents the average of those plants (identified by asterisks in Table IX-1) which practice a high degree of wastewater recycle from the machine end (wind box, raw material transfer, etc.). Plants with recycle rates equal to or greater than 88% were used in this analysis. The Agency considers plants with these recycle rates representative of the best plants in this subcategory. The plants used to develop the model flow rates are representative of other sintering operations and include wastewaters from the wind box and other sources. Plant 0060F, at which wastewaters are recycled and the lowest discharge rate is achieved, was not included in the development of the model flow rate. The scrubber system at this plant uses steam and is different than scrubbers commonly used at sintering operations. The data in Table IX-1 demonstrate that the model effluent flow of 120 gal/ton is achieved at several plants including those that recycle wastewaters from only the discharge end or from both ends of the operation. The

Agency believes that the model flow rate can be achieved at all wet sintering plants by providing or increasing the rate of recycle.

It should be noted that those flows averaged to develop the model effluent flow are for plants in which process wastewaters are generated at the machine end of the sintering operation. The pollutant loads in machine end process wastewaters were typically found to be greater than the loads in discharge end, both end, or cooling wastewaters (refer to process descriptions in Section III and to the analytical data in Section VII). Recycle rates and discharge flows achieved in systems with more highly contaminated wastewaters, demonstrate the ability of those operations with less contaminated wastewaters to achieve similar discharge flows and recycle rates. Referring to Table IX-1, applied flows in several instances (discharge end, both end, or contact cooling) approach or are less than the model effluent flow. The Agency concludes that the treatment model effluent flow, and resultant recycle rate, are well demonstrated in this subcategory.

Justification of the BPT Effluent Limitations

Table IX-2 presents plant effluent data which support the BPT limitations. These data show two stand-alone plants in compliance with the BPT effluent limitations for suspended solids and oil and grease. The pH at Plant 0396A is higher than the maximum pH limitation of 9.0 standard units. The pH alone will not affect the levels of the other BPT limited pollutants and, therefore, has no bearing on this particular analysis. Several other sintering operations are in compliance with the BPT effluent limitations. Many of these (Plants 0060, 0112D, 0448A, 0584C, 0860B, and 0864A) are part of central treatment systems.

TABLE IX-1

BPT FLOW SUMMARY AND JUSTIFICATION SINTERING SUBCATEGORY

Plant Code	Applied Flow (gal/ton)	Discharge Flow (gal/ton)	Operating Mode	Origin of Process Wastewaters	Basis
0448A	UNK	0	RTP-100	B	DCP
0060F	301	26	RTP-91	A	VISIT
0868A	100	70	RTP-30	D	DCP
0920F*	2124	74	RTP and RUP-94	A	D-DCP
0396A	341	80	RTP-75	B	VISIT
0584F	106	106	OT	B	DCP
0856Q*	2805	117	RTP-96	A	DCP
0112B	133	133	OT	C	DCP
0920B	134	134	OT	C	DCP
0948C*	1124	135	RUP-88	A	DCP
0112D*	1432	142	RTP-90	A	VISIT
0060	1667	219	RTP and RUP-80	C	D-DCP
0856F	220	220	OT	C	D-DCP
0432A	245	245	OT	C	VISIT
0112A	1604	288	RTP and RUP-77	B	D-DCP
0112C	1292	793	RTP-39	B	DCP
0584C	1368	1368	OT	A	DCP
0864A	2819	1733	RTP-38	C	D-DCP
0060B	2186	2186	OT	C	DCP
0492A	2582	2582	OT	C	DCP
0946A	6605	6605	OT	A	DCP

A: Front end of operation (e.g., wind box, machine-other than wind box, storage and handling area dusts)

B: Discharge end of operation.

C: Both ends of operation.

D: Contact cooling of the product only.

*: Denotes those plants used to determine the BPT treatment model effluent flow. The average recycle rate of these plants is 92% and the average discharge flow is 117 gal/ton.

TABLE IX-2

JUSTIFICATION OF BPT EFFLUENT LIMITATIONS SINTERING SUBCATEGORY

	Discharge Flow (gal/ton)	Suspended Solids	Oil and Grease	pH	C&TT Components
BPT Effluent Limitations	120	0.0250	0.0050	6-9	FLP,T,VF,RTP-92,NA
Plant Discharge Data					
0396A	80	0.00307	0.000334	12.8	FLP,CL,CT,VF,RTP-77
0920F	74	0.017	0.0043	8.1	NC,CL

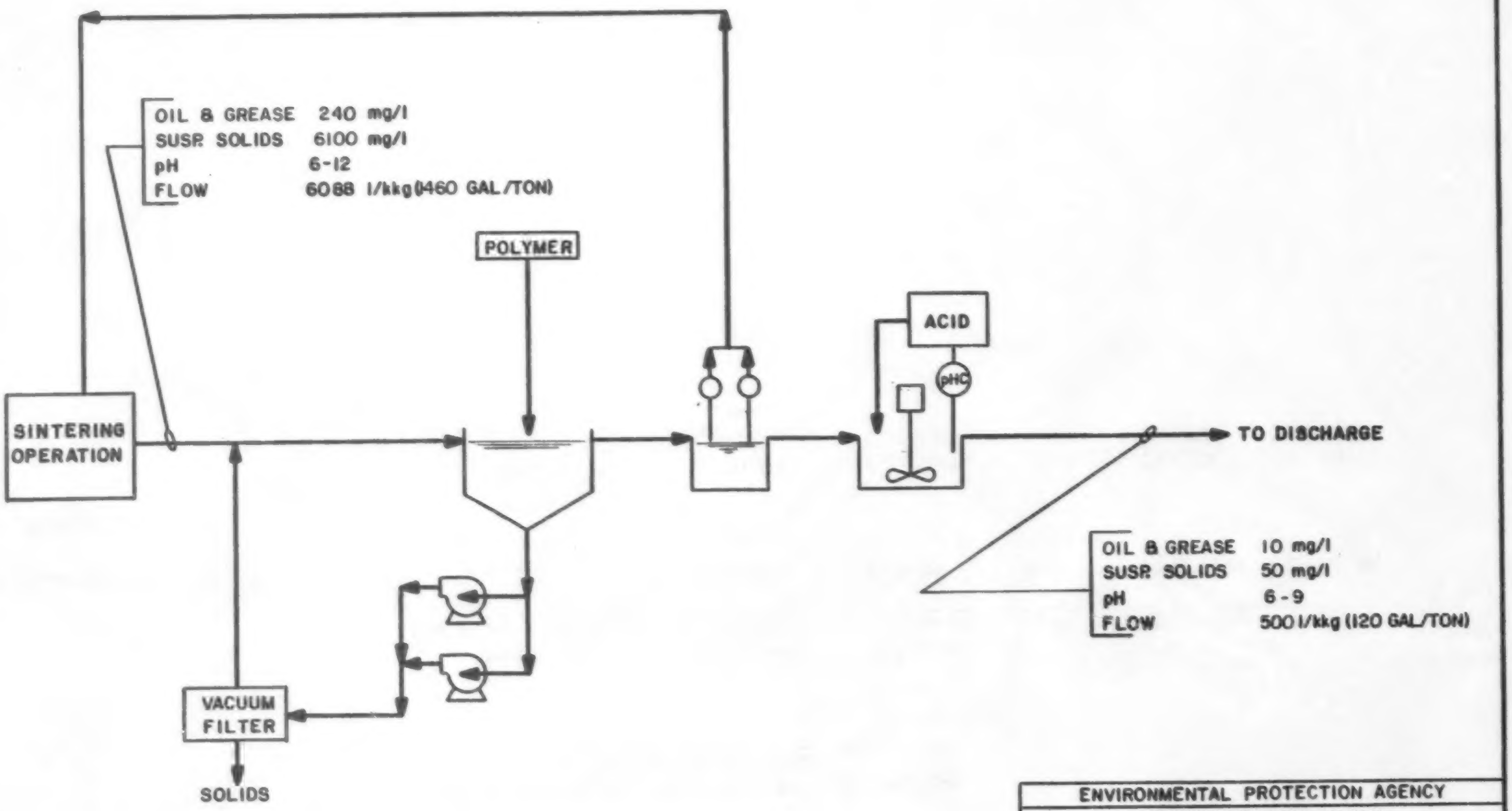
OIL & GREASE 240 mg/l
SUSP. SOLIDS 6100 mg/l
pH 6-12
FLOW 6088 l/kkg (1460 GAL/TON)
POLYMER
SINTERING OPERATION
ACID
pHC
TO DISCHARGE
OIL & GREASE 10 mg/l
SUSP. SOLIDS 50 mg/l
pH 6-9
FLOW 500 l/kkg (120 GAL/TON)
VACUUM FILTER
SOLIDS

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FIGURE IX-1

SINTERING SUBCATEGORY

SECTION X

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE

Introduction

The Best Available Technology Economically Achievable (BAT) effluent limitations are to be achieved by July 1, 1984. BAT is determined by reviewing subcategory practices and identifying the best economically achievable control and treatment technology employed within the subcategory. In addition, where a treatment technology is readily transferable from another subcategory or industry, such technology may be identified as BAT.

This section identifies five BAT treatment alternatives which the Agency considered for the sintering subcategory. In addition, the rationale for selecting the BAT model treatment system flow rates and effluent pollutant concentrations are reviewed. Finally, the rationale for selecting the BAT model treatment system is discussed.

Identification of BAT

Based upon the information contained in Sections III through VIII, the following alternative treatment systems were developed to supplement the BPT model treatment system. These treatment systems are illustrated schematically in Figure VIII-1.

1. BAT Alternative 1

   In the first BAT Alternative, the BPT blowdown flow of 120 gal/ton is filtered to reduce the levels of toxic metals and suspended solids. The pH of the effluent is adjusted using acid. The pH adjustment step is a BPT component which has been relocated in the sequence of treatment steps.

2. BAT Alternative 2

   BAT Alternative 2 includes lime precipitation and sedimentation of the BPT treatment system blowdown for toxic metals control and subsequent pH control.

3. BAT Alternative 3

   This alternative includes the treatment system components of BAT Alternative 2, and adds two-stage (alkaline) chlorination following clarification for the purpose of oxidizing cyanide, phenols, and other toxic organic pollutants. The chlorinated effluent is dechlorinated with an appropriate reducing agent prior to discharge.

4. BAT Alternative 4

   The fourth BAT alternative treatment system includes the treatment system components of BAT Alternative 3 with filtration and adsorption on granular activated carbon for removal of toxic organic pollutants added as the final treatment steps prior to discharge.

5. BAT Alternative 5

   In this alternative zero discharge is achieved by evaporating the BPT treatment system blowdown and returning all of the condensate to the process.

Investment and annual costs for the BAT alternative treatment systems are presented in Section VIII.

Rationale for the Selection of BAT

Treatment Technologies

The model BAT applied and discharge flows are based upon the same recycle rate (92%) and discharge flow used to develop the BPT effluent limitations. Referring to Table IX-1, the average and individual recycle rates of the plants used to develop the model BAT effluent flow support a 92% recycle rate. The Agency has included filtration in some of the model BAT treatment systems to reduce the toxic metal effluent loads. Removal of toxic metals is accomplished by removal of suspended solids, in which the metals are entrained. Three of the 21 "wet" sintering plants are equipped with filtration as part of central wastewater treatment systems. Filtration is also used extensively in other steel industry subcategories (e.g., ironmaking, basic oxygen furnace, continuous casting, and hot forming) and in other industries for the removal of suspended particulate matter from similar wastewater streams.

Lime addition for the purpose of pH adjustment and precipitate formation is a common wastewater treatment practice. The use of clarifiers for wastewater sedimentation is common in this subcategory and in a wide variety of other subcategories and industries.

Two-stage (alkaline) chlorination is included as a means of controlling cyanide, ammonia-N, and phenols and other toxic organic pollutants. Alkaline chlorination is practiced at two plants in this subcategory as part of co-treatment with blast furnace wastewaters. Dechlorination using reducing agents is included to control excess residual chlorine. Dechlorination is practiced at one central treatment plant which receives sintering process wastewaters.

Activated carbon adsorption is included to remove any toxic organic pollutants which may remain after treatment by alkaline chlorination. Activated carbon is used in one sinter plant application, where ironmaking and sintering process wastewaters are co-treated.

Flows

Refer to Table IX-1 for the data used to develop the model BAT treatment system effluent flow. The plants which have recycle rates of 90% or more approach or exceed the model BPT recycle rate of 92%. As noted in Section IX, the Agency believes that a recycle rate of 92% and a model effluent flow of 120 gal/ton are appropriate for the BAT model treatment systems. Aside from the use of vapor compression distillation, the Agency is not aware of other methods to further reduce the discharge volume.

Wastewater Quality

Reference is made to the ironmaking subcategory report for a complete discussion of the development of effluent limitations for ammonia-N, total cyanide, phenols (4AAP), and total residual chlorine applicable when sintering wastewaters are co-treated with ironmaking wastewaters.

Toxic Metal Pollutants

To determine the effluent concentrations for the toxic metal pollutants, the Agency evaluated monitoring data from several sources. The Agency reviewed long-term filtration system effluent data from similar wastewater treatment applications and pilot treatability study data to determine the toxic metals removal capabilities of filtration systems. A review of these data and the monitoring data presented in Section VII indicate that the toxic metals are present in particulate form. The toxic metals effluent concentrations used to develop the BAT effluent limitations are the same as those used to establish the toxic metal limitations for ironmaking wastewaters. These concentrations are achievable by sintering operations and were used to facilitate co-treatment with ironmaking wastewaters, a common practice in the industry. These toxic metals concentrations are support by the pilot filtration data for plant 0060 presented in Table X-1. Lime precipitation and sedimentation data from the same source are presented in Table X-2.

Sulfide addition was considered for treatment of toxic metals. However, because of the marginal incremental toxic metal removal over other technologies, and because this technology has not been demonstrated in this subcategory, the Agency did not consider sulfide precipitation as an alternate BAT technology.

Effluent Limitations for the BAT Alternatives

The effluent limitations associated with the BAT treatment alternatives were developed on a mass basis (kg/kkg or lb/1000 lb) by applying the model plant effluent flow of 120 gal/ton to the respective BAT treated effluent concentrations of each pollutant. The effluent limitations for each alternative were established using the procedures outlined in Volume I. The effluent flow and concentrations have been previously documented in this section. Table X-3 presents the effluent limitations developed for each treatment alternative. The flow and concentration basis for the limitations are also presented.

Selection of a BAT Alternative

The Agency selected BAT Alternative 1 (depicted in Figure X-1) as the BAT model treatment system. The Agency determined that BAT Alternative 1 provides significant benefits with regard to reductions in toxic pollutant effluent loads and should be the BAT model treatment system. While Alternative 1 is the selected BAT option, the Agency believes that Alternative 2 (lime precipitation) can also be used to achieve the BAT limitations. Except as noted below, the Agency does not believe that the relatively low levels of ammonia-N, total cyanide, phenols (4AAP) and other toxic organic pollutants warrant the application of more advanced technologies including two-stage alkaline chlorination and activated carbon to all sintering plants. Evaporation technology to eliminate the discharge (Alternative 5), while technically feasible, is extremely costly and was not selected on that basis.

The Agency recognizes that co-treatment of compatible sintering and ironmaking wastewaters is practiced at several plants. Accordingly, the Agency has promulgated effluent limitations for ammonia-N, total cyanide, phenols (4AAP), and total residual chlorine which are applicable to sintering wastewaters when these wastewaters are co-treated with ironmaking wastewaters. The achieveability of these limitations are demonstrated by the performance at Plant 0860 B which is discussed in detail in the ironmaking subcategory report. These sintering BAT limitations are based upon the model plant effluent data for sintering and ironmaking operations and the sintering model plant flow of 120 gal/ton. The promultation of BAT limitations for ammonia-N, total cyanide, and phenols (4AAP) for sintering operations is consistent with the Agency's co-treatment policy. Greater discharges of toxic and non-conventional pollutants will not result when these wastewaters are co-treated rather than treated separately. The levels of these pollutants in BPT treatment system effluents is close to that found in ironmaking wastewaters after treatment by alkaline chlorination.

The BAT effluent limitations are presented on Table X-3 under the BAT Alternative 1 heading. The achievability of these limitations is demonstrated by the performance data developed from the pilot study and the fact that the model flow rate is well demonstrated. The model flow rate is the same as the BPT model treatment system flow rate. Table X-4 justifies the sintering BAT limitations for a sintering operation co-treated with an ironmaking operation.

TABLE X-1

PILOT TREATABILITY STUDY DATA ANALYSIS: FILTRATION
SINTERING SUBCATEGORY
(STUDIES WERE CONDUCTED AT PLANT 0060)

Pollutant	No. of Observations	Minimum Concentration(1)	Maximum Concentration(1)	Average Concentration(1)	Daily Maximum Performance Standard(1)	30-Day Average Performance Standard(1)
Fluoride	12	10	43	18	50.9	21.2
Oil and Grese	6	<5	9	5.7	9.7	6.2
pH (Units)	12	6.9	9.0	6.9 - 9.0	-	-
Phenols (4AAP)	12	0.01	0.22	0.07	0.32	0.09
Total Suspended Solids	11	1	7	3.1	9.3	3.6
118 Cadmium	12	<0.01	0.013	0.01	0.01	0.01
119 Chromium	12	<0.01	0.43	0.17	1.69	0.22
120 Copper	12	<0.02	0.03	0.02	0.02	0.02
121 Cyanide	12	0.03	0.26	0.13	0.44	0.15
122 Lead	12	<0.02	<0.02	<0.02	0.03	0.02
124 Nickel	12	<0.01	0.023	0.013	0.02	0.01
128 Zinc	12	0.02	0.47	0.18	1.04	0.23

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(1) All concentrations are expressed in mg/l unless otherwise noted.

TABLE X-2

PILOT TREATABILITY STUDY DATA ANALYSIS: LIME PRECIPITATION AND SEDIMENTATION
SINTERING SUBCATEGORY
(STUDIES WERE CONDUCTED AT PLANT 0060)

Pollutant	No. of Observations	Minimum Concentration	Maximum Concentration	Average Concentration	Daily Maximum Performance Standard	30-Day Average Performance Standard
Fluoride	12	12	43	18.4	41.3	21.1
Oil and Grease	8	1	5	2.9	10.1	3.3
pH (Units)	12	9.6	10.3	9.6 - 10.3	-	-
Phenols (4AAP)	12	0.10	0.43	0.19	0.48	0.22
Total Suspended Solids	11	4	92	47.4	238	55
118 Cadmium	12	<0.01	<0.01	<0.01	<0.01	<0.01
199 Chromium	12	0.025	0.29	0.14	0.62	0.16
120 Copper	12	<0.02	<0.02	<0.02	<0.02	<0.02
121 Cyanide	12	0.02	0.11	0.07	0.19	0.08
122 Lead	12	<0.02	0.18	0.03	0.12	0.05
124 Nickel	12	<0.01	0.033	0.013	0.03	0.02
128 Zinc	12	0.02	0.08	0.04	0.09	0.04

TABLE X - 3
ALTERNATIVE BAT EFFLUENT LIMITATIONS
SINTERING SUBCATEGORY

		BAT ALTERNATIVE 1		BAT ALTERNATIVE 2		BAT ALTERNATIVE 3		BAT ALTERNATIVE 4		BAT ALTERNATIVE 5	
		CONCENTRATION BASIS (mg/l)	EFFLUENT LIMITATIONS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT LIMITATIONS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT LIMITATIONS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT LIMITATIONS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT LIMITATIONS (kg/kkg)
DISCHARGE FLOW (gal./ton)		120	——	120	——	120	——	120	——	0	——
AMMONIA (as N)(1)	Ave.	——	——	——	——	10	0.00500	10	0.00500	——	——
	Max.	——	——	——	——	30	0.0150	30	0.0150	——	——
CYANIDE (Total)(1)	Ave.	——	——	——	——	1	0.000500	1	0.000500	——	——
	Max.	——	——	——	——	2	0.00100	2	0.00100	——	——
PHENOLS (4 AAP)(1)	Ave.	——	——	——	——	0.1	0.000050	0.1	0.000050	——	——
	Max	——	——	——	——	0.2	0.000100	0.2	0.000100	——	——
RESIDUAL CHLORINE(1)	Max.	——	——	——	——	0.5	0.000250	0.5	0.000250	——	——
LEAD	Ave	0.25	0.000125	0.25	0.000125	0.25	0.000125	0.25	0.000125	——	——
	Max.	0.75	0.000375	0.75	0.000375	0.75	0.000375	0.75	0.000375	——	——
ZINC	Ave.	0.3	0.000150	0.3	0.000150	0.3	0.000150	0.3	0.000150	——	——
	Max.	0.9	0.000450	0.9	0.000450	0.9	0.000450	0.9	0.000450	——	——

(1) BAT EFFLUENT LIMITATIONS for Ammonia (N), Total Cyanide, Phenols (4 AAP), and Residual Chlorine, are based upon BAT Alternative 3 and are applicable only when sintering wastewaters are co-treated with ironmaking wastewaters.
Limitations for lead and zinc are based upon BAT Alternative 1, the selected alternative.

TABLE X-4

JUSTIFICATION OF BAT EFFLUENT LIMITATIONS SINTERING SUBCATEGORY

	30-Day Average Limitations				
BAT Limitations	Ammonia-N (lb/day)	Cyanide (lb/day)	Phenols-4AAP (lb/day)	Lead (lb/day)	Zinc (lb/day)
Sintering(1)	166.3	16.6	1.7	4.2	5.0
Ironmaking(1)	120.4	12.0	1.2	3.0	3.6
Total	286.7	28.6	2.9	7.2	8.6
Current Discharge of Plant 0860B	47.4	0.7	0.1(2)	NA	1.4

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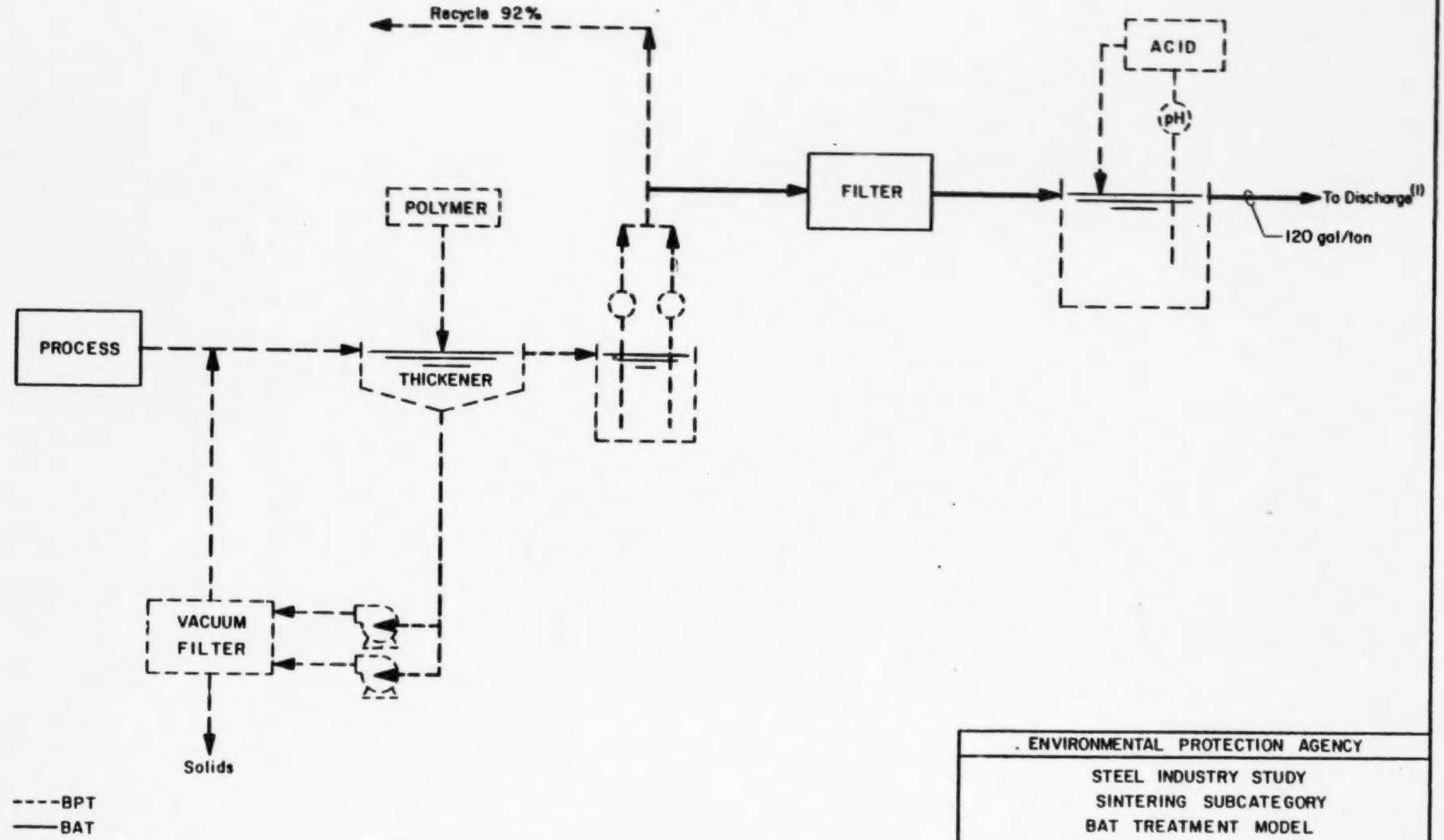
(1) Sintering Production - 16,600 TPD (from DCP)
Ironmaking Production - 20,611 TPD (from DCP)

(2) Represents activated carbon treatment.

NA: No analyses performed.


Recycle 92%
ACID
pH
POLYMER
FILTER
To Discharge(1)
120 gal/ton
PROCESS
THICKENER
VACUUM FILTER
Solids
----BPT
—BAT

(1) For effluent quality and loads, refer to Table X-3.

. ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
SINTERING SUBCATEGORY
BAT TREATMENT MODEL

Dwn. 11/19/81

FIGURE X-I

SINTERING SUBCATEGORY

SECTION XI

BEST CONVENTIONAL POLLUTANT CONTROL TECHNOLOGY

Introduction

The 1977 Amendments added Section 301(b)(2)(E) to the Act establishing "best conventional pollutant control technology" (BCT) for discharges of conventional pollutants from existing industrial point sources. Conventional pollutants are those defined in Section 304(a)(4) [biochemical oxygen demanding pollutants (BOD_5), total supended solids (TSS), fecal coliform, and pH], and any additional pollutants defined by the Administrator as "conventional" (oil and grease, 44 FR 44501, July 30, 1979).

BCT is not an additional limitation but replaces BAT for the control of conventional pollutants. In addition to other factors specified in Section 304(b)(4)(B), the Act requires that BCT limitations be assessed in light of a two part "cost-reasonableness" test. American Paper Institute v. EPA, 660 F.2d 954 (4th Cir. 1981). The first test compares the cost for private industry to reduce its conventional pollutants with the costs to publicly owned treatment works for similar levels of reduction in their discharge of these pollutants. The second test examines the cost-effectiveness of additional industrial treatment beyond BPT. EPA must find that limitations are "reasonable" under both tests before establishing them as BCT. In no case may BCT be less stringent than BPT.

EPA published its methodology for carrying out the BCT analysis on August 29, 1979 (44 F.R. 50732). In the case mentioned above, the Court of Appeals ordered EPA to correct data errors underlying EPA's calculation of the first test, and to apply the second cost test. (EPA had argued that a second cost test was not required.)

EPA has determined that the BAT technology is capable of removing significant amounts of conventional pollutants. However, EPA has not yet proposed or promulgated a revised BCT methodology in response to the American Paper Institute v. EPA decision mentioned earlier. Thus, it is not now possible to apply the BCT cost test to this technology option. Accordingly, EPA is deferring a decision on the appropriate BCT limitations until EPA proposes the revised BCT methodology.

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SINTERING SUBCATEGORY

SECTION XII

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF NEW SOURCE PERFORMANCE STANDARDS

Introduction

NSPS are to be established based upon a consideration of the degree of effluent reduction achievable through the application of the Best Available Demonstrated Control Technology (BADCT), processes, operating methods, or other alternatives including, where practicable, a standard permitting no discharge of process wastewater pollutants to navigable waters. The Agency concluded that zero discharge, however, is not a feasible treatment alternative for "wet" sintering operations. As discussed in Sections VII and X, there are no technologies applicable to all sintering operations that would result in attainment of zero discharge in a cost effective manner. Zero discharge may be achieved at new sintering operations by installing dry air cleaning systems. However, the Agency did not establish NSPS on this basis since, in some instances, "wet" air cleaning systems may be more effective and more appropriate for given applications. NSPS alternative treatment systems and effluent standards have been developed to accommodate the use of "wet" air cleaning systems.

Identification and Basis for NSPS Treatment Scheme and Flow Rates

NSPS Alternative 1

This alternative is identical to BPT and BAT Alternative 1 (refer to Sections IX and X). This system includes sedimentation of raw process wastewaters in a thickener in conjunction with the addition of a flocculant to enhance solids removal. Treatment process sludges are dewatered by vacuum filtration. Most of the thickener effluent (92%) is recycled to the process, while the remaining thickener effluent is discharged as a blowdown. The recycle blowdown undergoes filtration to remove toxic metals and suspended solids. Prior to discharge, the pH of the treated effluent is adjusted, as necessary, to the neutral range with acid.

NSPS Alternative 2

This alternative is identical to BPT and BAT Alternative 2. Lime precipitation and clarification, instead of filtration, of the recycle system blowdown noted above is included for toxic metals removal.

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NSPS Alternative 3

This alternative is identical to BPT and BAT Alternative 3. Two-stage alkaline chlorination is included in this alternative for the purpose of cyanide, ammonia and phenol oxidation. Dechlorination is provided prior to discharge.

NSPS Alternative 4

This alternative is identical to BPT and BAT Alternative 4. This alternative provides for the removal, by activated carbon adsorption, of the remaining toxic organic pollutants that may be present.

NSPS Alternative 5

This alternative is the same as BPT and BAT Alternative 5 and provides for zero discharge by the use of evaporation technologies.

In order to accommodate process developments which would be included in the construction of a new source "wet" sintering operation, the Agency examined various industry trends. In all likelihood, new sintering operations will have greater production capacities than the 4000 tons/day used for BPT and BAT model treatment systems. The Agency averaged the production capacities of sintering operations constructed in the last decade and, based upon that average, established a new source model size of 7,000 tons/day, which was used for NSPS costing. Although the effluent limitations (kg/kkg of product) developed for the BAT model treatment systems are the same as those for the new source systems, the increased model size for new source operations results in increased treatment model capital and annual costs due to the increase in the volume of wastewater requiring treatment. A review of the subcategory summary data indicates that the model BPT and BAT applied and discharge flows are applicable to new "wet" sintering operations. Trends which might affect flow were not detected.

The NSPS treatment systems described above are depicted in Figure VIII-1. The corresponding effluent levels and loads are presented in Table XII-1. Cost data for NSPS are presented in Section VIII.

Rationale for Selection of NSPS

The NSPS alternative treatment systems include the same components described for the BPT and BAT model treatment systems discussed in Sections IX and X. Reference is made to those sections for a review of the treatment technologies.

Selection of an NSPS Alternative

The Agency selected NSPS Alternative 1, depicted in Figure XII-1, as the NSPS model treatment system. This alternative was selected for the same reasons noted in Section X regarding the selection of the BAT model treatment system (i.e., the benefits derived from reduction in the effluent loads of various pollutants).

The NSPS are presented in Table XII-1 under the heading of NSPS Alternative 1. As noted in Section X for BAT, NSPS for ammonia-N, total cyanide, phenols (4AAP), and total residual chlorine have been promulgated to accommodate co-treatment of new source ironmaking and sintering wastewaters.

Justification of NSPS

Recycle of sintering wastewaters is practiced at several plants. Reference is made to Table IX-1 which lists these plants. Filtration of sintering wastewaters is practiced at plants 0584C, 0860B, 0920B, and 0946A. Lime or caustic precipitation and alkaline chlorination are practiced at plant 0860B. Alkaline chlorination is also practiced at plants 0432A and 0946A. Reference is made to Tables X-1, X-4, and XII-2 for demonstration of NSPS for sintering operations.

TABLE XII - I
ALTERNATIVE NSPS
SINTERING SUBCATEGORY

		NSPS ALTERNATIVE I		NSPS ALTERNATIVE 2		NSPS ALTERNATIVE 3		NSPS ALTERNATIVE 4		NSPS ALTERNATIVE 5	
		CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)
DISCHARGE FLOW (gal./ton)		120	——	120	——	120	——	120	——	0	——
TOTAL SUSPENDED SOLIDS	Ave.	15	0.00751	25	0.0125	25	0.0125	15	0.00751	——	——
	Max.	40	0.0200	70	0.0350	70	0.0350	40	0.0200	——	——
OIL & GREASE	Max.	10	0.00500	10	0.00500	10	0.00500	10	0.00500	——	——
pH		Within the range 6.0 to 9.0		Within the range 6.0 to 9.0		Within the range 6.0 to 9.0		Within the range 6.0 to 9.0		——	
AMMONIA (as N)(1)	Ave.	——	——	——	——	10	0.00500	10	0.00500	——	——
	Max.	——	——	——	——	30	0.0150	30	0.0150	——	——
CYANIDE (Total)(1)	Ave.	——	——	——	——	1	0.000500	1	0.000500	——	——
	Max.	——	——	——	——	2	0.00100	2	0.00100	——	——
PHENOLS (4 AAP)(1)	Ave.	——	——	——	——	0.1	0.000050	0.1	0.000050	——	——
	Max.	——	——	——	——	0.2	0.000100	0.2	0.000100	——	——
RESIDUAL CHLORINE(1)	Max.	——	——	——	——	0.5	0.000250	0.5	0.000250	——	——
LEAD	Ave.	0.25	0.000125	0.25	0.000125	0.25	0.000125	0.25	0.000125	——	——
	Max.	0.75	0.000375	0.45	0.000375	0.45	0.000375	0.45	0.000375	——	——
ZINC	Ave.	0.3	0.000150	0.3	0.000150	0.3	0.000150	0.3	0.000150	——	——
	Max.	0.9	0.000450	0.9	0.000450	0.9	0.000450	0.9	0.000450	——	——

(1) NSPS for Ammonia (N) Total Cyanide, phenols (4AAP), and residual chlorine are based upon NSPS Alternative 3 and are applicable only when sintering wastewaters are co- treated with ironmaking wastewaters.
NSPS for all other pollutants are based upon NSPS Alternative 1, the selected alternative.

TABLE XII-2

JUSTIFICATION OF NSPS
SINTERING SUBCATEGORY

	Total Suspended Solids (kg/kkg)	Oil and Grease (kg/kkg)	pH (Units)	Lead (kg/kkg)	Zinc (kg/kkg)	C&TT Components
NSPS	0.00751	0.00500	6.0 to 7.0	0.000125	0.000150	FLP,T,VF,RTF, NA,FP
Plants						
J (396A)	0.00307	0.000334	12.8*	NA	NA	FLP,CL,CT,VF, RTP-77
920F	0.017*	0.0043	8.1	NA	NA	NC,CL, T,VF

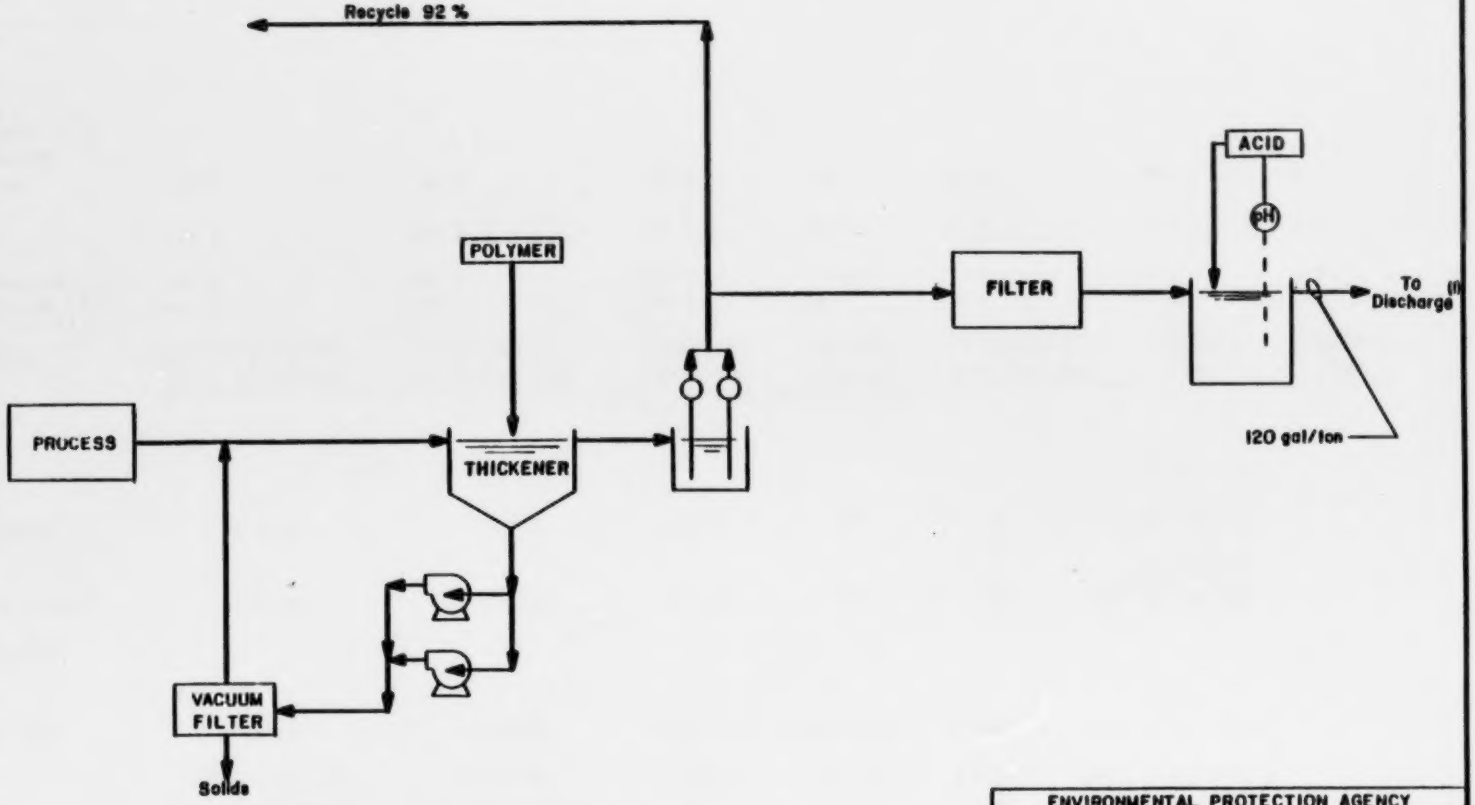
	30-Day Average Standards						
NSPS	Total Suspended Solids (lb/day)	Oil and Grease (lb/day)	Ammonia-N (lb/day)	Cyanide (lb/day)	Phenols-4AAP (lb/day)	Lead (lb/day)	Zinc (lb/day)
Sintering(1)	249.3	166.3	166.3	16.6	1.7	4.2	5.0
Ironmaking(1)	180.6	120.4	120.4	12.0	1.2	3.0	3.6
Total	429.9	286.7	286.7	28.6	2.9	7.2	8.6
Current Discharge of Plant 0860B	53.9	24.6	47.4	0.7	0.1(2)	NA	1.4

---

(1) Sintering Production - 16,600 TPD (from DCP)
Ironmaking Production - 20,611 TPD (from DCP)

(2) Represents activated carbon treatment.

NA: No analyses performed.
* : The NSPS standards are not justified by these data.


Recycle 92 %
POLYMER
PROCESS
THICKENER
VACUUM FILTER
Solids
FILTER
ACID
pH
To Discharge (1)
120 gal/ton

(1) For effluent quality and loads refer to Table XII-1

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY

SINTERING SUBCATEGORY
NSPS TREATMENT MODEL

DWN. 1/8/79

FIGURE XII-1

SINTERING SUBCATEGORY

SECTION XIII

PRETREATMENT STANDARDS FOR DISCHARGES TO PUBLICLY OWNED TREATMENT WORKS

Introduction

This section presents pretreatment alternatives for sintering operations with discharges to publicly owned treatment works (POTWs). One sintering plant currently discharges process wastewaters to a POTW. The general pretreatment and categorical pretreatment standards applicable to sintering operations are discussed below.

General Pretreatment Standards

For detailed information on Pretreatment Standards refer to 46 FR 9404 et seq., "General Pretreatment Regulations for Existing and New Sources of Pollution," (January 28, 1981). See also 47 FR 1518 (February 1, 1982). In particular, 40 CFR Part 403 describes national standards (prohibited and categorical standards), revision of categorical standards through removal allowances, and POTW pretreatment programs.

In establishing pretreatment standards for sintering operations, the Agency considered the objectives and requirements of the General Pretreatment Regulations. The Agency determined that uncontrolled discharges of wastewaters from sintering operations to POTWs would result in pass-through of toxic pollutants.

Identification of Pretreatment Alternatives

PSES and PSNS alternative treatment systems are identical to the BPT model treatment and the BAT alternative treatment systems (refer to Sections IX and X for a discussion of these treatment systems). These alternatives are set out below and illustrated in Figure XIII-1.

PSES/PSNS Alternative 1 - Flocculant addition, gravity sedimentation in a thickener, vacuum filtration of sludges, and recycle (92%) of the system effluent. This alternative is the same as the model BPT treatment system.

PSES/PSNS Alternative 2 - Filtration of the blowdown from the first alternative. This system is the same as BAT Alternative 1.

PSES/PSNS Alternative 3 - Lime addition and clarification, are included to treat the blowdown from the first alternative.

PSES/PSNS Alternative 4 - Two-stage (alkaline) chlorination is included after lime addition and clarification.

PSES/PSNS Alternative 5 - Filtration and adsorption on activated carbon are added to PSES and PSNS Alternative No. 4 for removal of toxic organic pollutants which may be present.

PSES/PSNS Alternative 6 - The recycle system (PSES and PSNS No. 1) blowdown is processed by vapor compression distillation to achieve zero discharge.

Selection of a Pretreatment Alternative

The pretreatment alternatives described above are designed to control toxic metals, and thus are designed to minimize pass through of these pollutants at POTWs which receive sintering wastewaters. The six pretreatment alternatives accomplish between 93 percent and 100 percent removal of the toxic metal pollutants limited at PSES/PSNS.

PSES/PSNS Alternative 2 was selected as the basis for the promulgated PSES and PSNS. This alternative is the same as the selected BAT alternative for sintering operations. PSES/PSNS Alternative 2 provides for substantial removal of toxic metals without the high costs associated with evaporate technologies. More advanced treatment is not appropriate, as most of the toxic metals found in sintering wastewaters are in a particulate form. The removal rates of toxic metals from untreated sintering wastewaters for PSES/PSNS Alternative 2 are compared to the POTW removal rates for these metals:

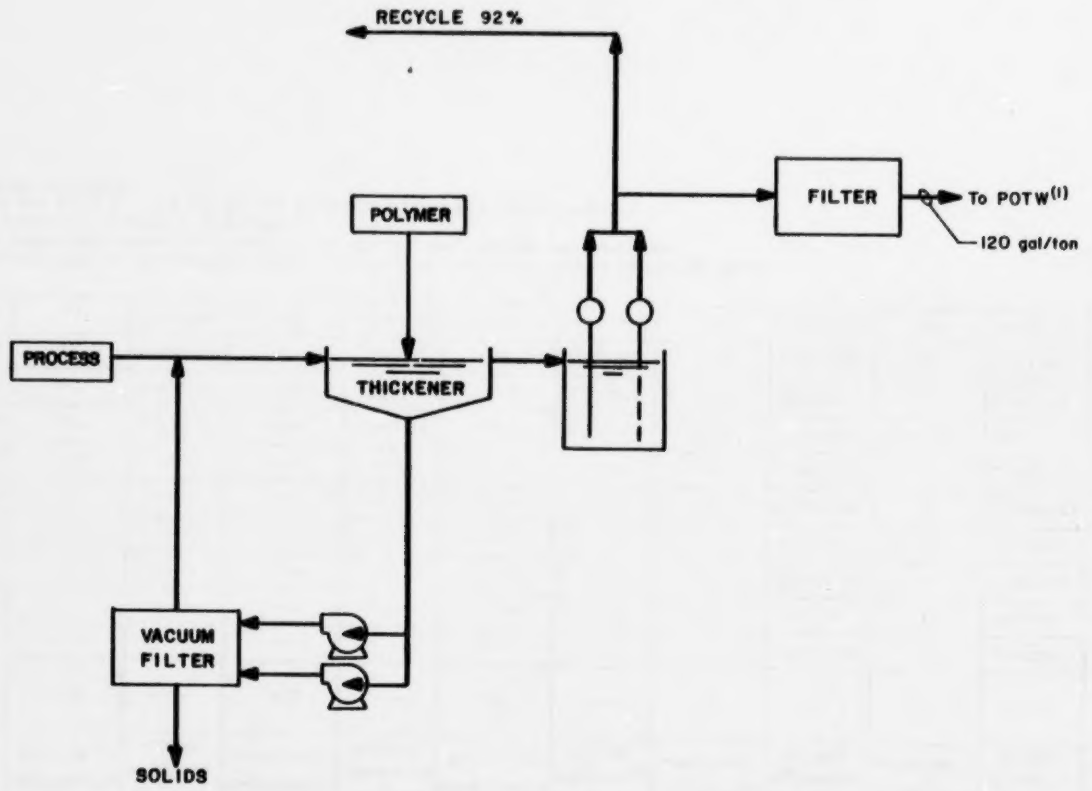
	PSES/PSNS Alternative 2	POTW
Lead	98.9%	48%
Zinc	98.5%	65%

As shown above, the selected PSES/PSNS alternative will prevent pass through of toxic metals at POTWs to a significantly greater degree than would occur if sintering wastewaters were discharged untreated to POTWs. The achievability of these standards is reviewed in Sections IX and X. The model treatment system is depicted in Figure XIII-1, and the PSES and PSNS are presented in Table XIII-1. Reference is made to Sections IX and X for demonstration of PSES and PSNS.

TABLE XIII - 1
ALTERNATIVE PSES AND PSNS
SINTERING SUBCATEGORY

		PSES/PSNS ALTERNATIVE 1		PSES/PSNS ALTERNATIVE 2		PSES/PSNS ALTERNATIVE 3		PSES/PSNS ALTERNATIVE 4		PSES/PSNS ALTERNATIVE 5		PSES/PSNS ALTERNATIVE 6	
		CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)	CONCENTRATION BASIS (mg/l)	EFFLUENT STANDARDS (kg/kkg)
DISCHARGE FLOW (gal./ton)		120	—	120	—	120	—	120	—	120	—	0	—
AMMONIA (as N)(1)	Ave	—	—	—	—	—	—	10	0.00500	10	0.00500	—	—
	Max	—	—	—	—	—	—	30	0.0150	30	0.0150	—	—
CYANIDE (Total)(1)	Ave.	—	—	—	—	—	—	1	0.000500	1	0.000500	—	—
	Max	—	—	—	—	—	—	2	0.00100	2	0.00100	—	—
PHENOLS (4 AAP)(1)	Ave.	—	—	—	—	—	—	0.1	0.000050	0.1	0.000050	—	—
	Max	—	—	—	—	—	—	0.2	0.000100	0.2	0.000100	—	—
LEAD	Ave.	0.25	0.000125	0.25	0.000125	0.25	0.000125	0.25	0.000125	0.25	0.000125	—	—
	Max.	0.75	0.000375	0.75	0.000375	0.75	0.000375	0.75	0.000375	0.75	0.000375	—	—
ZINC	Ave.	0.5	0.000225	0.3	0.000150	0.3	0.000150	0.3	0.000150	0.3	0.000150	—	—
	Max.	1.5	0.000751	0.9	0.000450	0.9	0.000450	0.9	0.000450	0.9	0.000450	—	—

(1) PSES and PSNS for Ammonia (N), Total Cyanide, Phenols (4 APP) and Residual Chlorine are based upon PSES/PSNS Alternative 4 and are applicable only when sintering wastewaters are co- treated with ironmaking wasewaters.
PSES and PSNS for lead and zinc are based upon PSES/PSNS Alternative 2, the selected alternative.


RECYCLE 92%
POLYMER
FILTER
To POTW(1)
120 gal/ton
PROCESS
THICKENER
VACUUM FILTER
SOLIDS

(1) For effluent quality and loads, refer to Table XIII-1.

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
SINTERING SUBCATEGORY
PSES & PSNS TREATMENT MODEL

Dwn.5/7/80

FIGURE XIII-1

IRONMAKING SUBCATEGORY

SECTION I

PREFACE

The USEPA has promulgated effluent limitations and standards for the steel industry pursuant to Sections 301, 304, 306, 307 and 501 of the Clean Water Act. The regulation contains effluent limitations for best practicable control technology currently available (BPT); best available technology economically achievable (BAT); pretreatment standards for new and existing sources (PSNS and PSES); and new source performance standards (NSPS). Effluent limitations for best conventional pollutant control technology (BCT) have been reserved for future consideration.

This part of the Development Document highlights the technical aspects of EPA's study of the Ironmaking Subcategory of the Iron and Steel Industry. Volume I of the Development Document addresses general issues pertaining to the industry while other volumes contain specific subcategory reports.

IRONMAKING SUBCATEGORY

SECTION II

CONCLUSIONS

Based upon this current study, a review of previous studies, and comments received on the proposed regulation (46 FR 1858), the Agency has reached the following conclusions:

1. In the proposed regulation, the ironmaking subcategory was subdivided into iron blast furnaces and ferromanganese blast furnaces. That subdivision has been maintained in this regulation. However, since there were no ferromanganese blast furnaces in operation during the data gathering period for this regulation (there are none presently in operation), the Agency has promulgated only the previous BPT limitations for ferromanganese blast furnaces and reserved all other limitations and standards (BAT, BCT, NSPS, PSES, PSNS). The Agency believes that BAT and BCT limitations and NSPS, PSES and PSNS for ferromanganese furnaces should be established on a case-by-case basis using the model wastewater treatment technology outlined for ironmaking blast furnaces. The Agency found no basis for further subdividing ironmaking into pig iron producers and ironmaking furnaces associated with steel production.

2. On the basis of the data collected for this study, the BPT effluent limitations originally promulgated in 1974 for iron and ferromanganese blast furnaces based upon recycle of process wastewaters, are practicable and achievable. The Agency has promulgated BPT limitations which are identical to those previously promulgated.

3. The Agency's monitoring of ironmaking blast furnace process wastewaters revealed significant discharges of nine toxic inorganic and eight toxic organic pollutants in addition to the currently limited pollutants. The Agency has concluded that the discharge of these pollutants can be controlled by the available, economically achievable technologies which include additional recycle and blowdown treatment consisting of lime precipitation and two-stage alkaline chlorination at the BAT level of treatment. A summary of raw waste loadings, and the discharges resulting from attainment of the BPT, BAT and PSES limitations and standards for ironmaking blast furnaces, is presented below:

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Pollutant Discharges (Tons/year)

	Direct Discharges			Indirect Discharges	
	Raw Waste	BPT	BAT	Raw Waste	PSES
Flow (MGD)	825.6	29.2	16.4	38.4	0.8
Ammonia (as N)	25,147.2	2,672.8	149.7	1,169.6	7.7
Cyanide, Total	15,088.3	178.2	0.7	701.8	0.04
Fluoride	18,860.4	2,004.6	498.9	877.2	25.6
Phenols (4AAP)	3,772.1	102.5	0.4	175.4	0.02
TSS	2,388,979.8	1,871.0	548.8	111,115.3	28.1
Toxic Metals	33,382.8	77.1	11.4	1,552.7	0.6
Toxic Organics[1]	201.2	7.1	4.0	9.4	0.2

[1] Does not include total cyanide or any of the individual phenolic compounds.

4. The Agency's estimates of the costs of compliance with the BPT and BAT limitations and PSES for the ironmaking subcategory are presented below for facilities in place as of July 1, 1981. The Agency has determined the effluent reduction benefits associated with compliance with the effluent limitations and standards justify these costs.

Costs (Millions of July 1, 1978 Dollars)

	Investment Costs			Annual Costs	
	Total	In-Place	Required	In-Place	Required
BPT	434.7	412.3	22.4	52.5	2.7
BAT	30.8	7.6	23.2	2.3	6.8
PSES	13.9	13.2	0.7	2.3	0.2

The Agency has also determined that the effluent reduction benefits associated with compliance with new source standards (NSPS, PSNS) justify those costs.

The estimated costs of compliance for BAT are based upon the Agency's assumption that the BAT model two-stage alkaline chlorination treatment system will be installed at each plant. However, the Agency expects that alternate less costly technologies will be installed at many plants. These technologies include minimization of blast furnace blowdowns with slag quenching; co-treatment of blast furnace wastewaters with cokemaking wastewaters in biological treatment systems, and certain innovative technologies that can achieve the BAT limitations at less or equal costs. The Agency estimates that 60 percent of the plants are currently able to evaporate process wastewaters on slag. The Agency has also determined that the effluent reduction benefits associated with compliance with new source standards (NSPS, PSNS) justify these costs.

5. The BPT and BAT model treatment systems for the ironmaking subcategory include wastewater recycle. Responses from the industry for several plants indicate that they do not experience scaling, fouling, or plugging problems with the recycle components used at those plants. The Agency has concluded that a 70 gal/ton blowdown is achievable and practicable as a component of the BAT model wastewater treatment system. A major steel company has recommended that the Agency base BAT limitations on a model flow of 35 gal/ton.

6. The Agency has not promulgated BCT limitations since the BCT cost methodology was remanded to the Agency for reconsideration.

7. The Agency has promulgated NSPS for ironmaking operations which are equivalent to the BAT limitations for toxic pollutants and provide for additional suspended solids control by filtration.

8. EPA has promulgated pretreatment standards for new (PSNS) and existing (PSES) sources which limit the quantities of toxic and nonconventional pollutants which can be introduced to POTWs. The PSES and PSNS are the same as the BAT limitations.

9. Although several toxic organic and toxic metal pollutants were found in untreated ironmaking wastewaters, the Agency believes it is not necessary to establish limitations for each toxic pollutant. The Agency believes that adequate control of toxic organic pollutants can be achieved by the control of total cyanide and phenols (4AAP). Likewise, control of lead and zinc will result in comparable control of other toxic metal pollutants.

10. To facilitate less costly central treatment and to make the ironmaking limitations compatible with those for sintering operations, the Agency has established an oil and grease effluent limitation for the ironmaking subcategory.

11. With regard to Third Circuit "remand issues," the Agency concludes that:

    a. Its estimated costs for the model wastewater treatment systems are sufficient to cover all costs required to install and operate the model technologies, whether as an initial fit or a retrofit. The Agency has also concluded that the ability to implement the model wastewater treatment systems is not affected by plant age. A comparison between the costs reported by the industry and the Agency's estimated costs for several plants demonstrates that the estimated model wastewater treatment costs are sufficient to account for all site-specific and other incidental costs which might be incurred.

    b. The use of recycle through cooling towers at the BPT and BAT levels of treatment and the use of evaporation of process wastewaters on slag as a means of achieving the BAT limitations will result in minor increases in water consumption. It is estimated that implementation of the technologies included in the BPT model treatment system will result in a net increase in water consumption of 3.0 MGD. This increase represents 0.35 percent of the total volume of water applied in this subcategory. Implementation of the treatment technologies included in the BAT model treatment system will result in a net increase of 3.1 MGD. This increase represents 0.36 percent of the total volume of water applied in this subcategory. However, recycle also significantly reduces or eliminates the discharge of pollutants. Since the total water consumption is small compared to total industry water usage, the Agency has concluded that the impact of the limitations on the consumptive use of water in this subcategory is minimal and is justified by the effluent reduction benefits resulting from their use. These technologies are presently in use at plants in "arid" and "semi-arid" regions.

12. Table II-1 presents the BPT effluent limitations for the ironmaking subcategory and the treatment model flow and effluent quality data used to develop these limitations. Table II-2 presents the BAT effluent limitations, and the NSPS, PSES, and PSNS for the ironmaking subcategory as well as the treatment model flow and effluent quality data used to develop these limitations and standards.

TABLE II-1

BPT MODEL FLOW, MODEL EFFLUENT QUALITY, AND EFFLUENT LIMITATIONS IRONMAKING SUBCATEGORY

Pollutant	Treatment Model Effluent Quality(1) Daily Maximum Concentration(1)	Treatment Model Effluent Quality(1) 30-Day Average Concentration(1)	Effluent Limitations (kg/kkg of Product) Daily Maximum Limitations	Effluent Limitations (kg/kkg of Product) 30-Day Average Limitations
Ironmaking Blast Furnace Operations				
Flow, gal/ton	125		NA	
pH, Units	6.0 to 9.0		6.0 to 9.0	
Ammonia (N)	309	103	0.161	0.0535
Phenols (4AAP)	12	4	0.00630	0.00210
Total Suspended Solids	150	50	0.0780	0.0260
121 Cyanide (T)	45	15	0.0234	0.00780
Ferromanganese Blast Furnace Operations				
Flow, gal/ton	250		NA	
pH, Units	6.0 to 9.0		6.0 to 9.0	
Ammonia (N)	1,233	411	1.29	0.429
Phenols (4AAP)	60	20	0.0624	0.0208
Total Suspended Solids	300	100	0.313	0.104
121 Cyanide (T)	450	150	0.469	0.156

NA: Not applicable

(1) Concentrations are expressed in mg/l unless otherwise noted.

TABLE II-2

MODEL FLOW, MODEL EFFLUENT QUALITY, AND EFFLUENT LIMITATIONS AND STANDARDS(1)
IRONMAKING SUBCATEGORY

		Treatment Model Effluent Quality		BAT Effluent Limitations(3)		
	Pollutant	Daily Maximum Concentrations(2)	30-Day Average Concentrations(2)	Daily Maximum Limitations	30-Day Average Limitations	BCT Effluent Limitations
	Flow, gal/ton	70		NA		(4)
	pH, Units	6.0 to 9.0		NA	NA	
	Ammonia (N)	30	10	0.00876	0.00292	
	Phenols (4AAP)	0.2	0.1	0.0000584	0.0000292	
	Residual Chlorine*	0.5	NA	0.000146	NA	
	TSS	40	15	NA	NA	
121	Cyanide (T)	2	1	0.000584	0.000292	
122	Lead	0.75	0.25	0.000219	0.0000730	
128	Zinc	0.9	0.3	0.000263	0.0000876	

		NSPS(3)		PSES(3)		PSNS(3)	
	Pollutant	Daily Maximum Standards	30-Day Average Standards	Daily Maximum Standards	30-Day Average Standards	Daily Maximum Standards	30-Day Average Standards
	Flow, gal/ton	NA		NA		NA	
	pH, Units	6.0 to 9.0		NA	NA	NA	NA
	Ammonia (N)	0.00876	0.00292	0.00876	0.00292	0.00876	0.00292
	Phenols (4AAP)	0.0000584	0.0000292	0.0000584	0.0000292	0.0000584	0.0000292
	Residual Chlorine*	0.000146	NA	NA	NA	NA	NA
	TSS	0.0117	0.00438	NA	NA	NA	NA
121	Cyanide (T)	0.000584	0.000292	0.000584	0.000292	0.000584	0.000292
122	Lead	0.000219	0.0000730	0.000219	0.0000730	0.000219	0.0000730
128	Zinc	0.000263	0.0000876	0.000263	0.0000876	0.000263	0.0000876

NA: Not applicable

* : The limitations and standards for residual chlorine shall be applicable only when chlorination of ironmaking wastewaters is practiced.

(1) BAT, BCT, NSPS

(2) Concentrations are expressed in mg/l unless otherwise noted.

(3) kg/kkg of product

(4) BCT is reserved.

IRONMAKING SUBCATEGORY

SECTION III

INTRODUCTION

General Discussion

The production of molten iron from coke, iron ores and beneficiated iron ores, sintered products, and limestone is an integral part of the basic steelmaking process. In 1980, blast furnace iron production in the United States supported about 61% (on a net tonnage basis) of U.S. raw steel production. The balance is produced directly from steel scrap in electric steelmaking remelting furnaces.

Process wastewaters are generated in ironmaking operations as a result of gas cleaning and cooling which permits the reuse of the gas as a fuel. Both iron and ferromanganese blast furnaces are included in this study.

The Agency previously promulgated a regulation governing blast furnace operations in 1974 and established limitations for the following pollutants:

Total Suspended Solids
Ammonia-N
Cyanide (Total)
Phenols (4AAP)
Fluoride
Sulfide
pH

Data Collection Activities

Industry responses to the basic questionnaires (DCPs) comprise the major source of data for blast furnace operations. The Agency requested information pertaining to production, processes, process water usage, process wastewater discharge, and wastewater treatment systems. The DCP responses for iron blast furnaces are summarized and tabulated in Table III-1. The DCP information for the ferromanganese blast furnace is summarized and tabulated in Table III-2.

The Agency sent detailed questionnaires (D-DCPs) to selected plants to gather cost and furnace operating data and long-term monitoring data. The responses to these questionnaires provided useful data which verified cost estimates, established retrofit costs (if any), and provided additional effluent quality data. The Agency identified 56 plants with blast furnace operations including two merchant pig iron producers. One firm claimed confidentiality with regard to all data submitted and collected by the Agency during surveys. These data do not appear in Table III-1. The Agency also identified one ferromanganese blast furnace and 164 iron blast furnaces at the 56 plants with blast furnace operations. Four of the iron blast furnaces are associated with merchant pig iron producers. The operation of 4 to 6 furnaces per plant is not uncommon and one plant had 11 active furnaces. Table III-3 summarizes the data base for ironmaking operations.

Description of the Blast Furnace Process

Blast furnaces are large cylindrical structures in which molten iron is produced by the reduction of iron bearing ores with coke and limestone. Reduction is promoted by blowing heated air into the lower part of the furnace. As the raw materials melt and decrease in volume, the entire mass of the furnace charge descends. Additional raw materials are added (charged) at the top of the furnace to keep the raw material mass within the furnace at a constant level.

Iron oxides react with the hot carbon monoxide from the burning coke, and the limestone reacts with impurities in the iron bearing material and the coke to form molten slag. These reactions start at the top of the furnace and proceed to completion as the charge passes to the bottom of the furnace. The molten slag, which floats on top of the molten iron, is drawn off (tapped) by way of a tapping hole. The molten iron is also tapped through a hole below the slag tapping hole.

The production of iron from a blast furnace is based upon the following approximate charge and yield relationships:

Raw Materials	Products
1.8 kkg iron ore	
0.6 kkg coke	0.9 kkg iron
0.45 kkg limestone	0.5 kkg slag
3.2 kkg air	4.5 kkg process gas

Blast furnace operations within the U.S. primarily produce (>99%) basic iron. Several plants have occasionally produced ferromanganese iron, although during this study only one ferromanganese furnace was found (Figure III-4). Production of iron (rated capacity) on a plant basis ranges from 800 to 22,200 TPD (Table III-4). The total rated capacity of all active operations is 294,260 TPD (excluding the confidential plant). Twenty-five percent of the plants account for 50 percent of the rated capacity.

The gases which are produced in the furnace are exhausted through the top of the furnace. These gases are cleaned, cooled, and then burned to preheat the incoming air to the furnace. Generally, gas cleaning involves the removal of the larger particulates by a dry dust collector, followed by a variety of "wet" or "wet/dry" gas cleaning systems for fine particulate removal. The three most common gas cleaning systems are illustrated in Figures III-1, 2, and 3. The first system (Type I) uses one wet scrubber (primary); the second (Type II) uses two wet scrubbers (primary and secondary); and the third (Type III) uses one wet scrubber and one dry air pollution control device. Gases are cooled with direct contact sprays in large gas cooling vessels. At many plants, all or a portion of the gas cooling wastewaters are cascaded to the gas cleaning systems described above.

Description of Wastewater Treatment

Prior to the mid 1970's, the treatment of ironmaking wastewaters consisted of the removal of suspended solids by sedimentation in conjunction with the addition of flocculating agents to improve removal efficiencies. The clarified wastewaters were typically discharged directly on a once-through basis without further treatment. Today, however, about ninety percent of the blast furnace wastewater treatment systems include recycle (after the thickener), and discharge only a relatively small percentage (generally 5 to 10%) of the process flow. Nearly all recycle systems employ cooling towers to reduce recycle wastewater temperatures. The thickener underflows are typically dewatered by vacuum filters with the filtrate returned to the thickener influent. The dewatered solids are either sent to sintering operations or to off-site disposal. The specific treatment practices in use at each plant are detailed in Table III-1 for iron blast furnace plants and in Table III-2 for the ferromanganese furnace.

TABLE III-1

GENERAL SUMMARY TABLE
IRONMAKING BLAST FURNACES

Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Daily Production (1976)	Applied Flow (gal/ton)**	Discharge Flow(gal/ton)**	Treatment Components: Process Treatment	Treatment Components: Central Treatment	Operating Mode	Discharge Mode
0060	1953		4730	3598	2001	140	CT,T	NW,SL(Unk), FLL,FLP,FLO(1) CL,SS	RTP 90	Direct
						40(Misc.Drains)	UNTREATED		OT	Direct
0060A	1928		1160	1220	2060	2060	SL(Unk), (FLP,CT,VF)	-	(RTP)	Direct
	1928		1400	817	3975	3975	(SL(Unk), (FLP,CT,VF)	-	(RTP)	Direct
0060B	1963		3600	3561	2507	2507	T	SSP,FLP,CL,VF	RET 100	Indirect
	1942		2000	2188	3093	3093	T	SSP,FLP,CL,VF	RET 100	Indirect
0060F	1964		2200	1665	5968	130	-	T,VF,FLP,CT	RTP 56 RUP 42 RET 2	ES
0112	1955	1973	3000	2790	1512	[71]	FLP,NA,T,CT,VF	-	RTP 96	Direct
	1943	1972	2600	Down(2070)*	1176					
	1953	1975	3000	2436	1664					
	1960	1976	2000	1696	2857					
0112A	NR	1928	1700	1641	7722	1973	T,CLA,FLP,(VF)	-	OT	Direct
	NR	1929	1700	1733	3822	2140	UNTREATED	-	OT	Direct
	NR	1959	2299	2266	2605					
	NR	1937	1800	2097	3159					
	1941		1800	Down(1700)*	5608	288	T,FLP,NA,CT,(VF)	-	RTP 93	Direct
	1948		3000	2664	3849					
	1953		3740	3092	4042					
	1957		3200	Down(2800)*	4464					
0112B	NR	1965	1100	Down(1060)*	2549	2549	T,VF,CT	-	(RTP)	Direct
	NR	1975	2500	2062						
	NR	1976	1850	981						
	NR	1967	1850	1660						
	NR	1969	2500	2211						
	1972		2750	2657						
0112C	NR	1957	2600	2257	1085	1085	-	T,VF,CT,(FLP)	(RTP)	Direct
	NR	1958	2600	2477	988	988	-	T,VF,CT,(FLP)	(RTP)	Direct
0112D	1972		5500	4943	[1567]	[73]	T,FLP,NA,CT,VF	CLA,NL,NW,NA, FLP,CL,SS,T, VF,SL(Unk)	RTP 97	Direct
0248A	1952		2000	1587	3902	3902	T,FLP,VF	-	OT	Direct

TABLE III-1
GENERAL SUMMARY TABLE
IRONMAKING BLAST FURNACES
PAGE 2

Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Daily Production (1976)	Applied Flow (gal/ton)**	Discharge Flow(gal/ton)**	Treatment Components: Process Treatment	Treatment Components: Central Treatment	Operating Mode	Discharge Mode
0256E	1953		2000	1381.5	5316	5316	T,VF	-	OT	Direct
0320	1920		NA	1625	2813	2813	T,VF,(FLP,CT,FP)	-	(RTP)	Direct
	1922		NA	1638	1959	1959	T,VF,(FLP,CT,FP)	-	(RTP)	Direct
	1948		NA	3007	1794	1794	T,VF,(FLP,CT,FP)	-	(RTP)	Direct
0384A	1907		2150	1613	3958	254	SL(Unk),T,NA,FLP, O(2),CT,(VF)	-	RTP 93	Direct
	1909		2100	1655	3288	211				
	1917	1963	2300	1767	3080	197				
	1926		2350	1689	3387	217				
	1939		3250	2461	3641	233				
	1942		3250	2319	3864	247				
	1947		3400	2374	2778	315	SL(Unk),NA,T, FLP,CT,(VF)	-	RTP 89	Direct
	1943		3400	2477	2663	302				
0396A	1907	1963	2100	1852	1944	194	T,FLP,NA, CT,T,VF	-	RTP 90	POTW
	1909	1965	1300	1005	2866	287				
0396C	1903		1500	Down(1100)*	929	929	CL,FLP	-	RET 100	Indirect
	1905		1680	849	2205	2205				
0426	1958		1100	760	6632	2615	T,CT,NA,VF,(FLP)	SL(Unk)	RUP 61,(RTP)	Direct
0432A	1909	1962	2000	Down(2000)*	[3091]	[3091]	***		(RTP)	Direct
							-	Scr,CLA,PSP, FLP,T,VF,CT	(RTP)	Direct
	1910	1970	3500	3057			-		RUP 27,(RTP)	Direct
	1910	1930	1500	1540			***		(RTP)	Direct
	1912	1966	2500	Down(2300)*			-		(RTP)	Direct
	1919		1599	1347			- -		RUP 40,(RTP) (RTP)	Direct Direct
0432B	1900		1175	1487	872	872	CLA,T,FLP,VF	-	OT	Direct
	1966		2500	1529	1742	1742				
	1904		1600	Down(1550)*	1115	1115				
0432C	1952	1972	2227	2374	1213	229	Scr,FLP,T,O(3), (CT)	-	RTP 81,(RTP)	Direct
	1963		3140	2732	1318	249				
0448A	1942		1675	1575	2743	NA	CL,SL(Unk),CT	-	RTP Unk RET Unk	ES and other processes & quenches
	1949		1675	1661	2601	NA				
	1953		1675	1389	3110	NA				
	1959		2175	2085	3591	NA				
0492A	1947		1200	1540	2057	2057	-	CL,SL(Unk),SS, VF,(FLP)	(RTP)	Indirect

TABLE III-1
GENERAL SUMMARY TABLE
IRONMAKING BLAST FURNACES
PAGE 3

Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Daily Production (1976)	Applied Flow (gal/ton)**	Discharge Flow(gal/ton)**	Treatment Components: Process Treatment	Treatment Components: Central Treatment	Operating Mode	Discharge Mode
0528A	1954		2500	2457	2066	$\boxed{66}$	-	MA,CL,FLP,VF, CT	RTP 97	Direct
	1958		2500	2546	2559					
0584B	1955		NA	2954	2025	2025	CL,T,VF,(FLP)	-	(RTP)	Direct
	1941		NA	2605						
	1938		NA	2487						
	1952		NA	2620						
0584C	1956		2600	2099	3224	3224	-	PSP,SS,SL, CLA,FDS(Unk), (FLP,VF,CT)	(RTP)	Direct
	1961		2600	2288	4406	4406				
0584D	1904		600	642	3892	3892	T,VF	-	OT	Direct
	1911		570	514	4861	4861				
	1911		980	998	2756	2756				
0584F	1919	1971	NA	2175	2317	2317	CL,VF,(FLP,CT)	-	(RTP)	Direct
	Pre 1940	1976	NA	1854	2718	2718				
	Pre 1940	1975	NA	1906	2644	2644				
	Pre 1940	1977	NA	1948	2587	2587				
0684A	1942		1260	1961	2203	2203	CL,VF	-	OT	Direct
	1926		1260	1565	3036	3036				
0684B	1921		2800	2565	3705	3705	(T,FLP,VF,CT)	-	(RTP)	Direct
0684F	1908		2100	1837	5546	$\boxed{626}$	PSP,Scr,FLP,FLL, FLC,CL,SS,VF,NA, CT	-	RTPand RUP-<90	Direct
	1916		1900	1745	5838					
	1943		2600	1943	6096					
	1952		2600	2017	5051					
0684G	1918		1250	976	1202	1202	-	PSP,ML,NW,FLL, FLO(4),FLP,CL, SS,VF	OT	Direct
	1906		1900	1754	3272	2286			RUP 30	Direct
0684H	1943		2870	2532	2345	188	A,FLL,FLP,CLA, CL,VF,CT	-	RTP 92	POTW

TABLE III-1
GENERAL SUMMARY TABLE
IRONMAKING BLAST FURNACES
PAGE 4

Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Daily Production (1976)	Applied Flow (gal/ton)**	Discharge Flow(gal/ton)**	Treatment Components: Process Treatment	Treatment Components: Central Treatment	Operating Mode	Discharge Mode
0684I	1918		800	916	5235	5235	FLP,T,VF,(CT)	SL(Unk),NW,SS	RUP 32,(RTP)	Direct
	1942		1500	1784	4746	1534	-	Central Treatment Only		Direct
						1679				
0724A	1902		1400	1177	795	697	T,(FLP,VF, CT)	-	RTP 12,(RTP)	Direct
	1902		1400	1433	1909	884			RTP 54,(RTP)	Direct
0732A	1952		800	1040	1800	0	T,O(4),(FLP,CT)	-	RTP <100	Direct
0856A	Inactive									
0856B	1943	1977	2500	1511	6490	4108	T,VF,(FLP,CT)	-	RUP 37,(RTP)	Direct
	1943		2300	2016	4864	3079	T,VF,(FLP,CT)	-	RUP 37,(RTP)	Direct
	1883		1800	1729	4464	4464	T,VF,(FLP,CT)	-	(RTP)	Direct
	1886		1100	1246	4519	4519	T,VF,(FLP,CT)	-	(RTP)	Direct
	1887		900	Down(972)*	9126	9126	T,VF,(FLP,CT)	-	(RTP)	Direct
0856F	1952		2607	2700	1851	1851	T,FLL,(VF,CT)	-	(RTP)	Direct
	1953		2820	2776	1800	1800				
	1957		2779	2872	1740	1740				
0856I	1901		NA	2241	3020	[60.7]	FLP,CL,T,VF,(CT)	-	(RTP)	Direct
	1901		NA	2122	3189		FLP,CL,T,VF,(CT)	-	(RTP)	Direct
	1907		NA	1118	4250		T,VF,(CT)	-	(RTP)	Direct
	1907		NA	1036	4587					
0856N	1898		NA	Down(1100)*	1047	[76.5]	T,SL(Unk),(FLP, VF,CT)	-	RTP(>90)	Direct
	1899		NA	1346	856					
	1942		NA	2326	532					
	1907		NA	Down(1100)*	1571					
	1941		NA	2718	1595					
0856O	1954		1234	1090	2202	2202	T,FLP,VF	-	OT	Direct.
0856Q	1907		1100	1009	6708	UNK	T,VF	-	RTP,RST 100	RS
0856R	1896		1000	Down(950)*	4030	1612	T,VF,(FLP,CT)	-	RTP 60,(RTP)	Direct
	1897		1250	1100						
	1897		1500	1451						
	1963		3000	2843	2431	2431	T,VF,(FLP,CT)	-	(RTP)	Direct
0856T	1901		1639	1666	2224	1443	PSP	-	OT	Direct
	1901		1517	1634	1983	781	UNTREATED	-	OT	Direct
	1909		1551	Down(1079)*	3059	1983	PSP	-	OT	Direct
						1204	PSP	-	OT	Direct
						1855	UNTREATED		OT	Direct

TABLE III-1
GENERAL SUMMARY TABLE
IRONMAKING BLAST FURNACES
PAGE 5

Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Daily Production (1976)	Applied Flow (gal/ton)**	Discharge Flow(gal/ton)**	Treatment Components: Process Treatment	Treatment Components: Central Treatment	Operating Mode	Discharge Mode
0860B	1917		894	1061	5282					
	1917		1959	2337	1658					
	1911		888	613	6098					
	1910		1980	1485	4935					
	1909		1981	1708	4755					
	1909		1721	1910	4161	[45.5]		SL(Unk),FLP,CL, (T,CLA,FF,ACG,CT)	(RTP)	Direct
	1909		980	564	12,176					
	1909		1818	1903	2634					
	1908		1105	1247	2721					
	1908		1137	1360	3543					
	1974		6148	5022	3297	358 (No Discharge)	FLP,T,VF,CT	-	RTP 89	ES
0860H	1970		4000	3073	2905		PSP,Scr,FLP,CL, T,VF,CT	-	RUP 32 RTP 64	ES
	1928		1512	1516	2945	120			RTP 96	
	1948		2200	2360	2227				RTP 96	
	1948		2200	Down(1958)*	3530				RTP 96	
0864A	1944		1900	1344	3482	1741	CL,SL(Unk)	Central Treatment present, but not described	RTP 50	Direct
	1944		1900	1344	3482	1741				
	1944		1900	1344	3482	1741				
0868A	1908		959	850	2095	2095	SL(Unk)	-	(RTP)	Direct
	1908		1096	861						
	1908		959	915						
	1928		1370	1109	[4350]	[149]	FLP,T,SL(Unk),CT	SL(Unk)	RUP 37 RTP 59	Direct
	1928		1370	1292	[3734]	[128]			RUP 37 RTP 59	Direct
	1941		2300	1728	[2917]	[100]			RUP 37 RTP 59	Direct
0920A	1903	1976	1550	1482	2915	2915	Scr,T,VF,(FLP,CT)	-	(RTP)	Direct
	1904	1969	1550	1279	3378	3378				
0920B	1913		1000	973	[2664]	[95]	-	PSP,FLP,CL, T,NA,VF,CT	RTP 96	Direct Direct
	1913		1000	Down(1000)*	[2592]	[92]	-		RTP 96	Direct Direct
	1948		2400	2192	[2891]	[74]	-		RUP 27 RTP 70	Direct
0920N	1948		1500	1502	2167	2167	T,VF,(FLP,CT)	-	(RTP)	Direct
	1950		900	Down(647)*	5030	5030	T,VF,(FLP,CT)	-	(RTP)	
	1948		1800	1850	3795	1459	T,VF,(FLP,CT)	-	(RTP)	

TABLE III-1
GENERAL SUMMARY TABLE
IRONMAKING BLAST FURNACES
PAGE 6

Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Daily Production (1976)	Applied Flow (gal/ton)**	Discharge Flow(gal/ton)**	Treatment Components		Operating Mode	Discharge Mode
							Process Treatment	Central Treatment		
0946A	1908		1000	Down(930)*	3220	2267	-	NC,CLA,FLP,T,VF	RTP 30	Direct
	1930		1400	1484				FDSP		
0948A	1908	1929	1200	1274	1808	93	T,VF	-	RTP 45	Direct
						904	UNTREATED		OT	Direct
	1908	1936	1200	Down(1000)*	2160	104	T,VF	-	RTP 42	Direct
						1152	UNTREATED		OT	Direct
	1910	1940	1500	1268	2271	117	T,VF	-	RTP 45	Direct
						1136	UNTREATED		OT	Direct
	1913	1942	1500	1742	951	96	T,VF	-	RTP 90	Direct
0948B	1918		1055	925	3892	3892	PSP	-	OT	Direct
0948C	1917	1948	2500	Down(1800)*	3152	82	T,VF,CT,(FLP)	-	RUP 48,RTP 50	Direct
	1925		1400	Down(1000)*	4896	158			RUP 35,RTP 61	Direct
	1953		2800	2526	1824	91			RTP 95	Direct
	1967		4000	4018	2724	82			RUP 39,RTP 58	Direct

---

* : Furnace was down in 1976; the value in parentheses represents 1975 average production.
** : Presented in English units for convenience of industry and government accustomed to working with English units. Multiply these values by 4.17 to convert to metric units.
***: A portion of the wastewater flow from this furnace is discharged untreated.
NR : No response provided in the DCP.
[ ] : Data enclosed in brackets was provided in D-DCP responses or long-term data requests, or obtained during sampling visits.
() : Components enclosed in parentheses were installed after 1/1/78.

KEY TO C&TT COMPONENTS

(1) Ferrous Sulfate
(2) Thermal Rotors
(3) Screw Classifier
(4) Sieve Plates

For definitions of the other C&TT codes, and other abbreviations, refer to Table VII-1.

TABLE III-2

GENERAL SUMMARY TABLE
FERROMANGANESE BLAST FURNACE

Plant Code	1st Year of Prod.	Last Major Rebuild	Rated Capacity (TPD)	Average Production (1976)	Applied Flow (gal/ton)	Discharge Flow(gal/ton)	Treatment Components Process Treatment	Treatment Components Central Treatment	Operating Mode	Discharge Mode
0112C	1925		676	534	[11,536]	[0]	CL,T,VF,CT	-	RTP 100	No discharge to navigable waters.

[ ] : Data enclosed in brackets was obtained during a sampling visit.

NOTE: For a definition of C&TT codes, and other abbreviations, refer to Table VII-1.

TABLE III-3

IRON MAKING BLAST FURNACE DATA BASE

	No. of Plants	Percent of Total No. of Plants	Rated Capacity (Tons/Day)	Percent of Rated Capacity
Plants sampled for original study	4	7.4	15,200	4.7
Plants sampled for toxic pollutant study	7	13.0	54,080*	16.8
Total plants sampled	11	20.4	69,280*	21.5
Plants responding via D-DCP	7	13.0	62,050	19.3
Plants sampled and/or responding via D-DCP(1)	15	27.8	116,640*	36.2
Plants which responded to DCP	54	100	321,511*	100.0

---

(1) Three plants which responded via D-DCP were also sampled during the toxic pollutant survey.

* : Does not include the tonnage of the confidential plant.

TABLE III-4

IRON MAKING FURNACE PRODUCTION
PLANTS RANKED FROM HIGHEST TO LOWEST PRODUCTION
(TONS PER DAY - RATED CAPACITY)

Reference Number	Rated Capacity TPD
0384A	22,200
0860B	20,611
0112A	19,140
0112B	12,550
0432A	11,000
0584B	10,900
0984C	10,700
0112	10,600
0112D	10,500
0860H	9,912
0684F	9,200
0856B	8,600
0856F	8,206
0868A	8,054
0584F	8,020
0856N	8,000
0448A	7,200
0856R	6,750
0856I	6,400
0320	6,270
0864A	5,700
0060B	5,600
0948A*	5,400
0432C	5,367
0432B*	5,275
0112C	5,200
0584C	5,200
0528A	5,000
0060	4,730
0856T*	4,707
0920B	4,400
0920N	4,200
0396A	3,400
0396C*	3,180
0684G	3,150
0920A	3,100
0684H	2,870
0684B	2,800

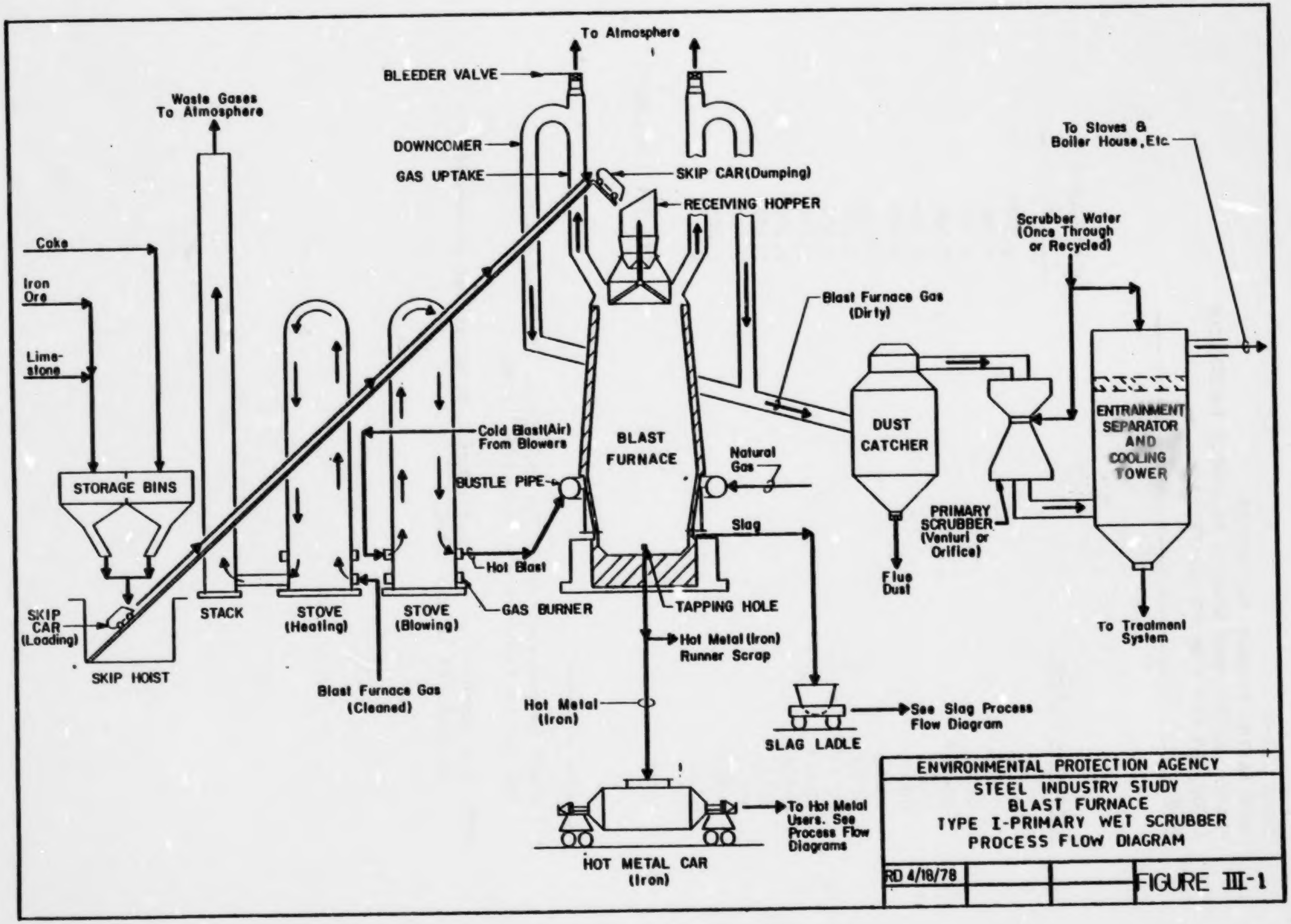
TABLE III-4
IRON MAKING FURNACE PRODUCTION
PLANTS RANKED FROM HIGHEST TO LOWEST PRODUCTION
(TONS PER DAY - RATED CAPACITY)
PAGE 2

Reference Number	Rated Capacity TPD
0724A	2,800
0060A	2,560
0684A	2,520
0946A*	2,400
0684I	2,300
0060F	2,200
0584D	2,150
0248A*	2,000
0256E*	2,000
08560*	1,234
0492A	1,200
0426	1,100
0856Q	1,100
0948B*	1,055
0732A	800
TOTAL	321,511 (294,260*)

---

* : Plant is now shutdown. The capacities of these plants are not included in the indicated total.

NOTE: The capacity of the confidential plant is not presented or included in the total.

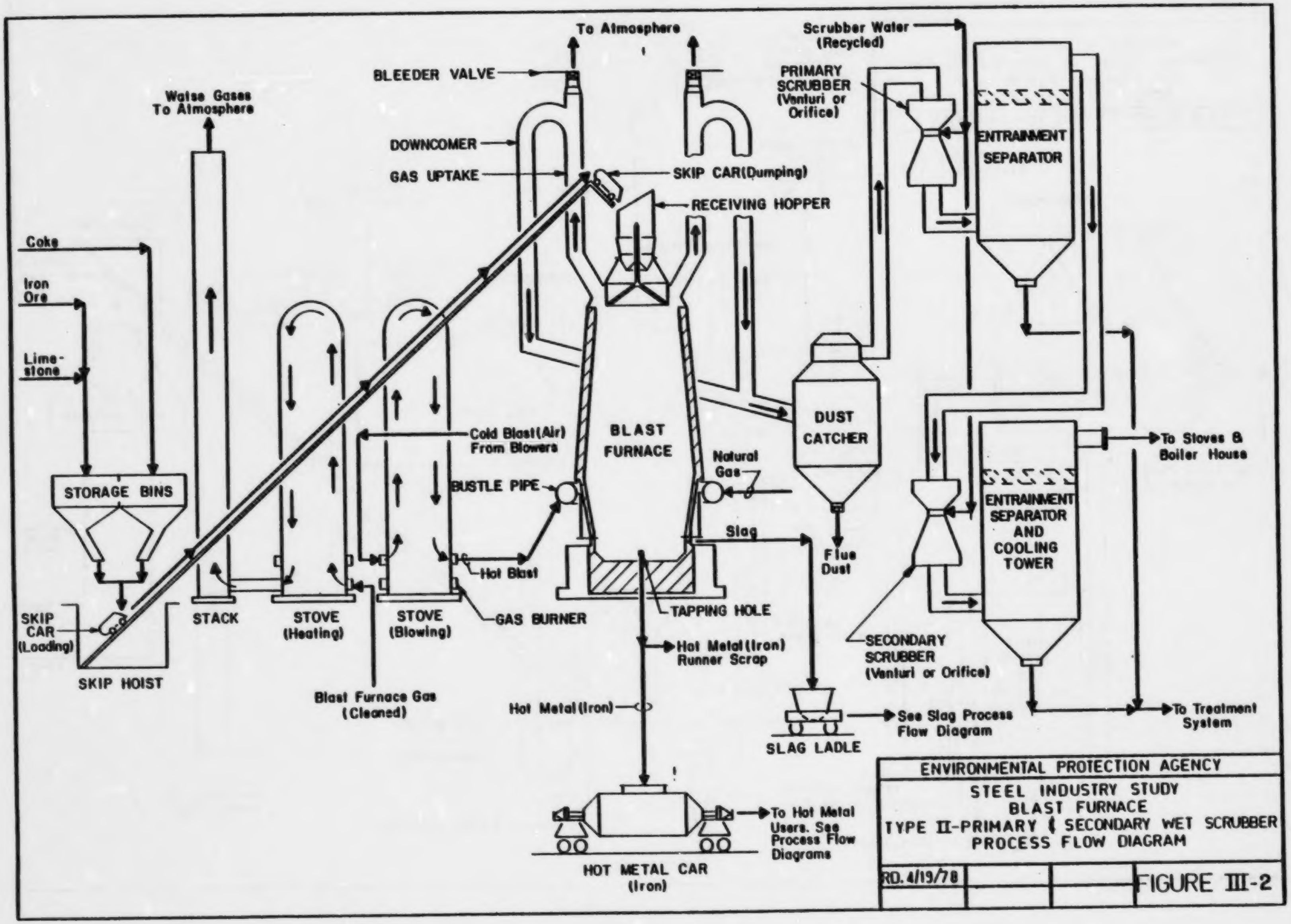

To Atmosphere
BLEEDER VALVE
Waste Gases
To Atmosphere
DOWNCOMER
GAS UPTAKE
SKIP CAR (Dumping)
RECEIVING HOPPER
To Stoves &
Boiler House, Etc.
Scrubber Water
(Once Through
or Recycled)
Coke
Iron
Ore
Lime-
stone
Blast Furnace Gas
(Dirty)
Cold Blast (Air)
From Blowers
BLAST
FURNACE
Natural
Gas
DUST
CATCHER
ENTRAINMENT
SEPARATOR
AND
COOLING
TOWER
STORAGE BINS
BUSTLE PIPE
Slag
PRIMARY
SCRUBBER
(Venturi or
Orifice)
Hot Blast
Flue
Dust
SKIP
CAR
(Loading)
STACK
STOVE
(Heating)
STOVE
(Blowing)
GAS BURNER
TAPPING HOLE
To Treatment
System
SKIP HOIST
Hot Metal (Iron)
Runner Scrap
Blast Furnace Gas
(Cleaned)
Hot Metal
(Iron)
See Slag Process
Flow Diagram
SLAG LADLE
To Hot Metal
Users. See
Process Flow
Diagrams
HOT METAL CAR
(Iron)

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BLAST FURNACE
TYPE I-PRIMARY WET SCRUBBER
PROCESS FLOW DIAGRAM

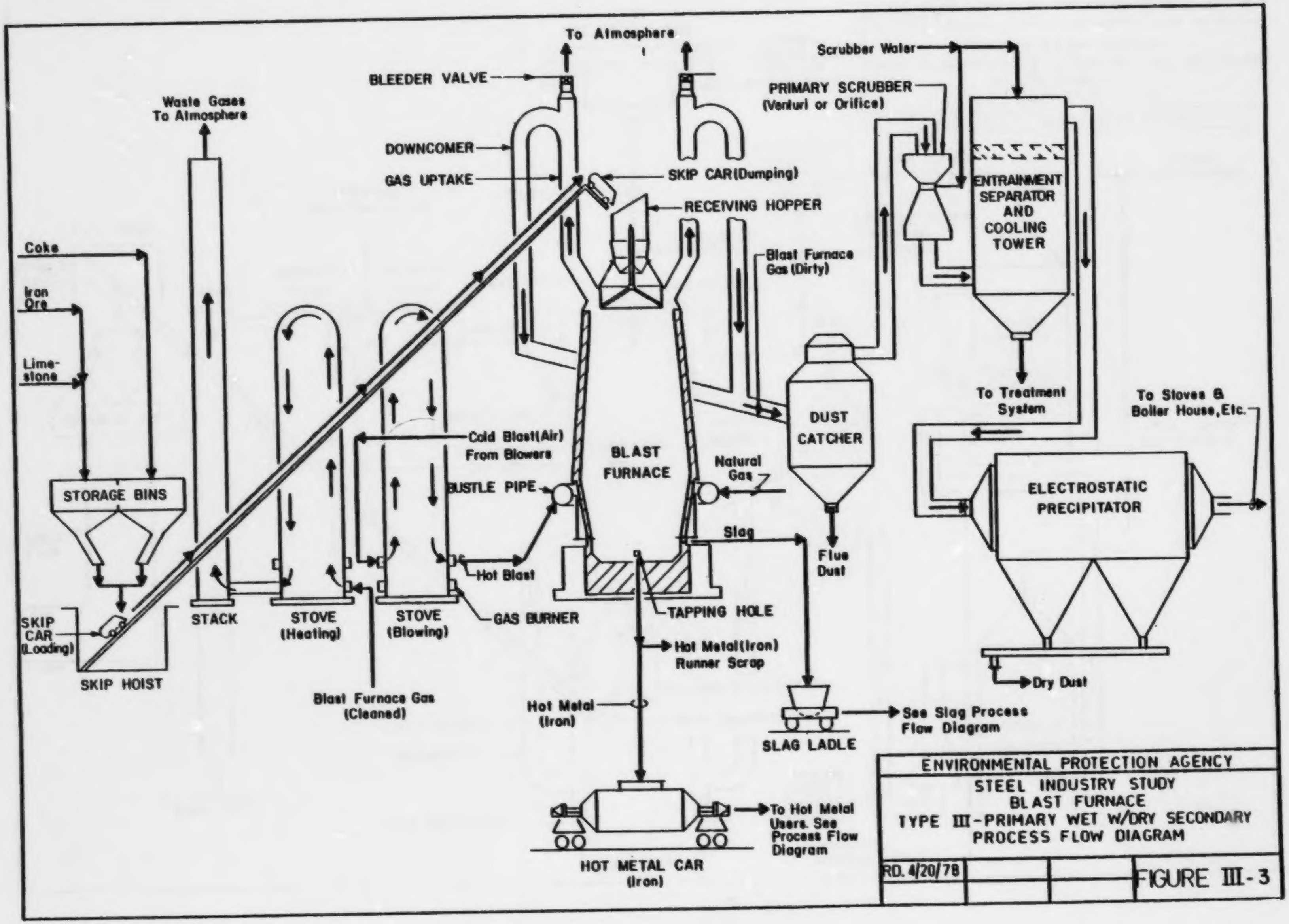
RD 4/18/78

FIGURE III-1


Coke
Iron Ore
Lime-stone
STORAGE BINS
SKIP CAR (Loading)
SKIP HOIST
Watse Gases To Atmosphere
STACK
STOVE (Heating)
STOVE (Blowing)
Blast Furnace Gas (Cleaned)
Cold Blast (Air) From Blowers
BUSTLE PIPE
Hot Blast
GAS BURNER
To Atmosphere
BLEEDER VALVE
DOWNCOMER
GAS UPTAKE
SKIP CAR (Dumping)
RECEIVING HOPPER
BLAST FURNACE
Natural Gas
Slag
TAPPING HOLE
Hot Metal (Iron) Runner Scrap
Hot Metal (Iron)
HOT METAL CAR (Iron)
To Hot Metal Users. See Process Flow Diagrams
DUST CATCHER
Flue Dust
SLAG LADLE
See Slag Process Flow Diagram
Scrubber Water (Recycled)
PRIMARY SCRUBBER (Venturi or Orifice)
ENTRAINMENT SEPARATOR
SECONDARY SCRUBBER (Venturi or Orifice)
ENTRAINMENT SEPARATOR AND COOLING TOWER
To Stoves & Boiler House
To Treatment System
RD. 4/19/78

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE
TYPE II-PRIMARY & SECONDARY WET SCRUBBER
PROCESS FLOW DIAGRAM

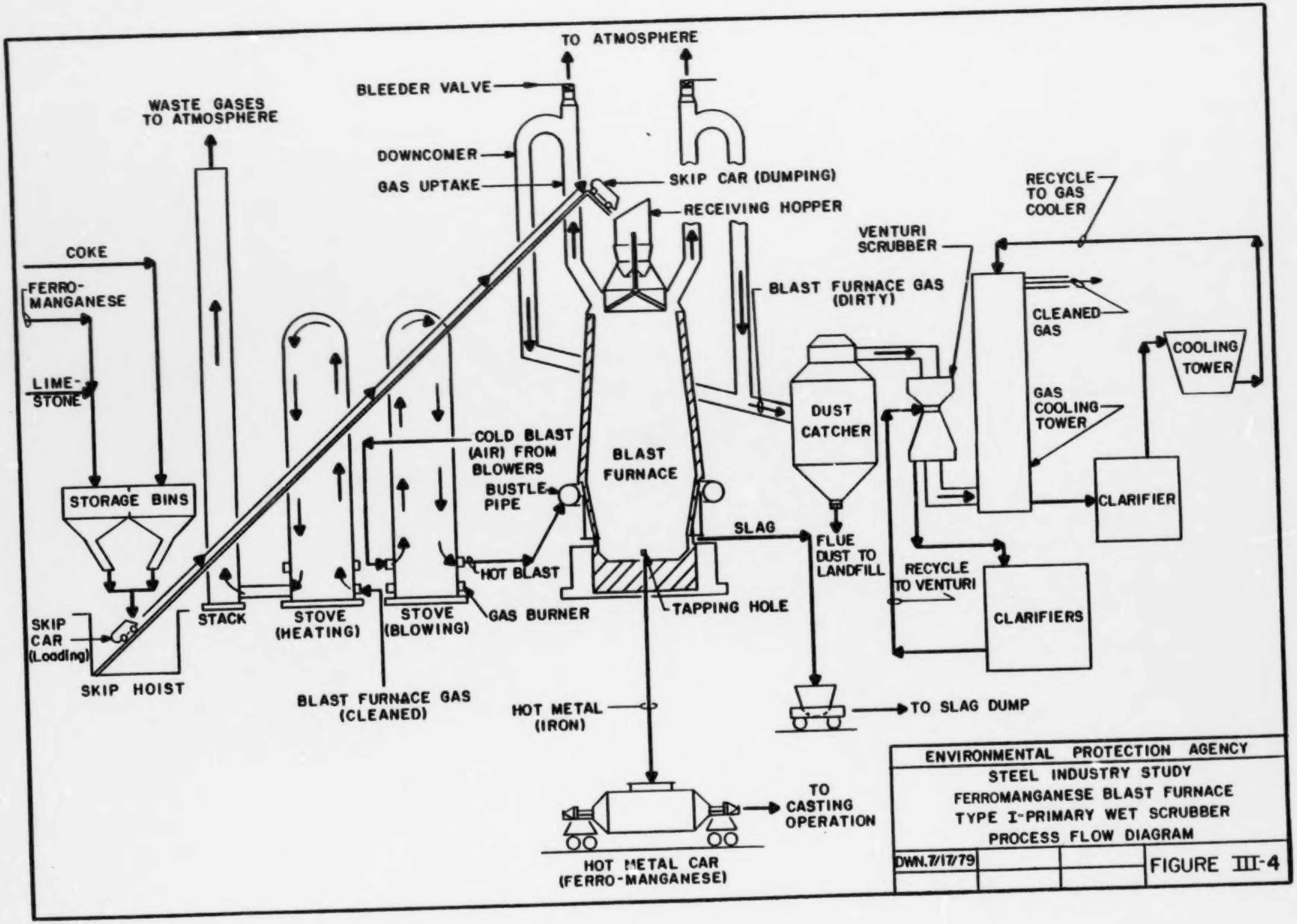
FIGURE III-2


To Atmosphere
BLEEDER VALVE
Waste Gases To Atmosphere
DOWNCOMER
GAS UPTAKE
SKIP CAR(Dumping)
RECEIVING HOPPER
Coke
Iron Ore
Lime-stone
Blast Furnace Gas (Dirty)
Scrubber Water
PRIMARY SCRUBBER (Venturi or Orifice)
ENTRAINMENT SEPARATOR AND COOLING TOWER
To Treatment System
To Stoves & Boiler House, Etc.
DUST CATCHER
Cold Blast(Air) From Blowers
BLAST FURNACE
Natural Gas
BUSTLE PIPE
STORAGE BINS
ELECTROSTATIC PRECIPITATOR
Slag
Flue Dust
Hot Blast
SKIP CAR (Loading)
STACK
STOVE (Heating)
STOVE (Blowing)
GAS BURNER
TAPPING HOLE
SKIP HOIST
Hot Metal(Iron) Runner Scrap
Dry Dust
Blast Furnace Gas (Cleaned)
Hot Metal (Iron)
See Slag Process Flow Diagram
SLAG LADLE
To Hot Metal Users. See Process Flow Diagram
HOT METAL CAR (Iron)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE
TYPE III-PRIMARY WET W/DRY SECONDARY
PROCESS FLOW DIAGRAM

RD. 4/20/78

FIGURE III-3


TO ATMOSPHERE
WASTE GASES TO ATMOSPHERE
BLEEDER VALVE
DOWNCOMER
GAS UPTAKE
SKIP CAR (DUMPING)
RECEIVING HOPPER
RECYCLE TO GAS COOLER
VENTURI SCRUBBER
BLAST FURNACE GAS (DIRTY)
CLEANED GAS
COOLING TOWER
GAS COOLING TOWER
COKE
FERRO-MANGANESE
LIME-STONE
STORAGE BINS
COLD BLAST (AIR) FROM BLOWERS
BUSTLE PIPE
BLAST FURNACE
DUST CATCHER
CLARIFIER
SLAG
FLUE DUST TO LANDFILL
RECYCLE TO VENTURI
CLARIFIERS
HOT BLAST
SKIP CAR (Loading)
STACK
STOVE (HEATING)
STOVE (BLOWING)
GAS BURNER
TAPPING HOLE
SKIP HOIST
BLAST FURNACE GAS (CLEANED)
HOT METAL (IRON)
TO SLAG DUMP
TO CASTING OPERATION
HOT METAL CAR (FERRO-MANGANESE)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
FERROMANGANESE BLAST FURNACE
TYPE I-PRIMARY WET SCRUBBER
PROCESS FLOW DIAGRAM

DWN. 7/17/79

FIGURE III-4

IRONMAKING SUBCATEGORY

SECTION IV

SUBCATEGORIZATION

Introduction

The steel industry is comprised of separate and distinct processes. Industry subcategorization was primarily affected by the individual processes, products, and wastewater characteristics. Other factors considered for subdivision were: raw materials, wastewater treatability, size, age, geographic location, and process water usage. With regard to ironmaking operations, differences between iron and ferromanganese blast furnaces were identified and found to justify subdividing the ironmaking subcategory. However, the Agency found no significant differences between blast furnaces producing pig iron and those associated with steel production. A discussion of each of these factors and the subdivision of the ironmaking subcategory follows.

Factors Considered in Subdivision

Manufacturing Process and Equipment

The production of iron and ferromanganese is unique within the steel industry because it is the only process in which iron bearing material, limestone and coke are converted into molten iron or ferromanganese. While many refinements have been made to blast furnaces to improve operating efficiencies, the basic process has remained unchanged. The refinements include more stringent control of the quality of raw materials, reaction rates and times within the furnace, the use of high top pressures, and oxygen and oil injection. However, these refinements have not had a major influence on the quality or quantity of the wastewaters generated during the ironmaking process and, thus, do not warrant further subdivision of this subcategory.

Final Product

Various grades of iron may be produced in a blast furnace (e.g., basic iron, ferromanganese, alloy iron), however, over the past decade more than 99% of the iron produced in this country was basic iron. Less than 1 percent of total blast furnace production was attributed to ferromanganese production. A review of the DCP data reveals that only five U.S. blast furnaces have historically produced iron other than pig iron and these furnaces produced only ferromanganese. Two of these five furnaces produced over 95% of the ferromanganese made in this country. At this writing, there are no ferromanganese furnaces in operation. The subdivisions already noted recognize the differences between iron and ferromanganese blast furnaces.

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Raw Materials

The major raw materials used for ironmaking are coke, iron ore, limestone, pellets, and sinter. Secondary raw materials include scrap, gravel, tars and oils of various types, mill scale, flux and dolomite. Following is a summary of the major raw materials used in the iron furnaces:

Feed Material	Mean of Burden	Mean lb/ton of Hot Metal
Coke	26.1	1,259
Iron Ore	14.0	744
Pellets	38.8	1,811
Sinter	23.7	1,096

For the one ferromanganese furnace, the raw material composition consisted of coke (36%), ferromanganese ore (47%), stone (12%) and other materials (5%). The use of large quantities of ferromanganese ore in the production of ferromanganese iron was a factor which distinguishes this process from the basic iron process. Other raw material differences are minor and, as such, do not warrant further subdivision of the ironmaking subcategory.

Wastewater Characteristics

Ironmaking process wastewaters result from cleaning (i.e., scrubbing) and cooling the dirty furnace exhaust gases. These gases are cleaned to a high degree and cooled so that they may be reused as fuel to preheat the air charged to the furnace and, in a number of instances, for steam production.

The gas streams contain dust, quantities of raw materials and process reaction products including many of the same pollutants found in cokemaking wastewaters. The phenolic pollutants found in ironmaking wastewaters are attributable to the coke used in the ironmaking process. Cyanide and ammonia (reaction products formed within the furnace or transferred from the coke charge to the furnace gases) are carried over with the gas stream and transferred to the scrubber waters. Several types of wet gas cleaning systems are used in the ironmaking subcategory (e.g., venturi scrubbers, adjustable orifice scrubbers, separators, spray chambers). The subdivisions already noted recognize the differences between iron and ferromanganese blast furnace wastewaters. Subdivision on the basis of the type of gas cleaning system is not warranted.

Wastewater Treatability

The basic treatment in place in ironmaking wastewaters includes the removal of suspended solids by gravity sedimentation and the recycle, to the scrubbers, of 90 to 95% of the wastewaters after cooling in evaporative cooling towers. Other pollutants (e.g., metals) associated with the suspended solids are also removed by the settling process. The quality and treatment of blast furnace wastewaters is similar throughout the subcategory and, as a result, subdivision on the basis of wastewater treatability is not warranted. The same type of treatment was provided for the previously noted ferromanganese furnace.

Size and Age

The Agency considered the impact of the size and age of ironmaking operations on the subdivision of the ironmaking subcategory. The Agency determined that age is of little importance because blast furnaces require periodic major rebuilding, typically every five to ten years. These major rebuilds often include substantial modifications to the furnace which, in many cases, is comparable to the construction of a new furnace. Most existing blast furnaces have been rebuilt many times, and some furnaces originally built in the early 1900's are still operating today. As the furnaces are rebuilt, various technological and production advancements are implemented to improve furnace operation and gas cleaning.

Figure IV-1 is a plot of effluent flow vs. plant age for plants with treatment and recycle facilities. This diagram demonstrates that there is no correlation between effluent flow and plant age, notably at flows less than 125 gal/ton (the BPT model flow). Effluent flow provides a measure of treatment capability, as recycle is one of the major treatment components used in developing the BPT, BAT, NSPS, PSES and PSNS alternative treatment systems and the respective effluent limitations and standards.

Although the age of a blast furnace is difficult to define, the Agency investigated the effect of age on the feasibility and cost of retrofitting pollution control equipment. The comparison of the age of a blast furnace with the year in which pollution control facilities were installed (see Table IV-1), demonstrates that pollution control equipment has been retrofitted at the oldest furnaces. As noted above, similar rates of pollutant discharge are achievable at blast furnaces of all ages. As a result, the Agency has concluded that retrofitting pollution control facilities to both old and new blast furnaces is feasible.

The cost of retrofitting the BPT systems to blast furnaces were provided by industry in DCP responses. The data show that retrofit costs amount to about 5 percent of the total capital cost of the pollution control equipment. In addition, as shown in Section VIII of this report, comparison of actual costs incurred by industry with the Agency's estimated costs for the same pollution control facilities, demonstrates that the Agency's estimates are sufficient to account for retrofit and other site-specific costs. The Agency thus concludes that the cost of retrofitting pollution control equipment at blast furnaces is not significant. Since more than 90% of the blast furnaces have been retrofitted with BPT water pollution control systems, the feasibility of retrofitting the BPT wastewater treatment system is well demonstrated. Compliance with BAT, on the other hand, will require the installation of add-on treatment systems which, in most instances, will not involve any significant retrofit costs.

The Agency evaluated the question of size by plotting effluent flow vs. production (Figure IV-2). This diagram demonstrates that there is no relationship between effluent flow and plant size as indicated by treatment and recycle facilities. It also demonstrates that the lower flows (representative of BPT and BAT model systems) are achieved at blast furnace operations with high production as well as low production. The Agency found that many plant sites have several blast furnaces. These furnaces range from old to new, and from small to large capacity.

Based upon the above, the Agency finds that both old and newer production facilities generate similar raw wastewater pollutant loadings; that pollution control facilities can be and have been retrofitted to both old and newer production facilities without substantial retrofit costs; that these pollution control facilities can and are achieving the same effluent quality; and, that further subcategorization or further segmentation within this subcategory on the basis of age or size is not appropriate.

Geographic Location

Location has no effect upon subdivision. Most blast furnaces are located in the predominant steel producing areas (e.g., Chicago, Pittsburgh, Cleveland). A few plants are located in water scarce areas and, as a result, these plants use operational methods (e.g., wastewater recirculation) which conserve water. As of July 1, 1978 about 54 percent of the plants (distributed throughout the country) had been retrofitted with recycle systems. Currently, recycle systems are installed at about 90 percent of the blast furnaces in the country. Of the 4 plants located in "arid" and "semi-arid" areas, 3 plants have installed and one operating recycle systems. The fourth plant is currently installing a recycle system. Also, wastewater quality among the plants surveyed is similar and, of the surveyed plants, one is located in an arid or semi-arid region, one in the southwest, and the others in the midwest and east.

Process Water Usage

The Agency examined process water usage as a possible basis for further subdivision. The data indicated that process wastewater flow had no significant impact on the ability to treat process wastewaters. In fact, many of the plants with the highest applied flows have lower discharge flows than plants with lower applied flows. Based upon these factors, the Agency concluded that further subdivision of the ironmaking subcategory based upon process water usage is not warranted.

TABLE IV-1

EXAMPLES OF RETROFIT
IRONMAKING SUBCATEGORY

		Plant Age	Treatment Age
Blast Furnace	0060B	1942	1958
	0112	1943	1962
	0112A	1941	1948
	0320	1920-1947	1976
	0384A	1907	1976
	0396A	1907-1909	1929
	0396C	1903-1905	1929
	0426	1958	1979
	0432A	1910-1919	1951
	0432B	1900-1966	1930
	0528A	1954	1977
	0584C	1956-1961	1965
	0584D	1904-1911	1953
	0684F	1908	1970, 1977
	0684G	1906	1971
	0684H	1943	1971
	0724A	1902	1974
	0856I	1901	1956,1970
	0860B	1908	1980
	0860H	1928	1968,1972
	0920B	1913	1976

FIGURE IV-1

BLAST FURNACE-RECYCLING PLANTS

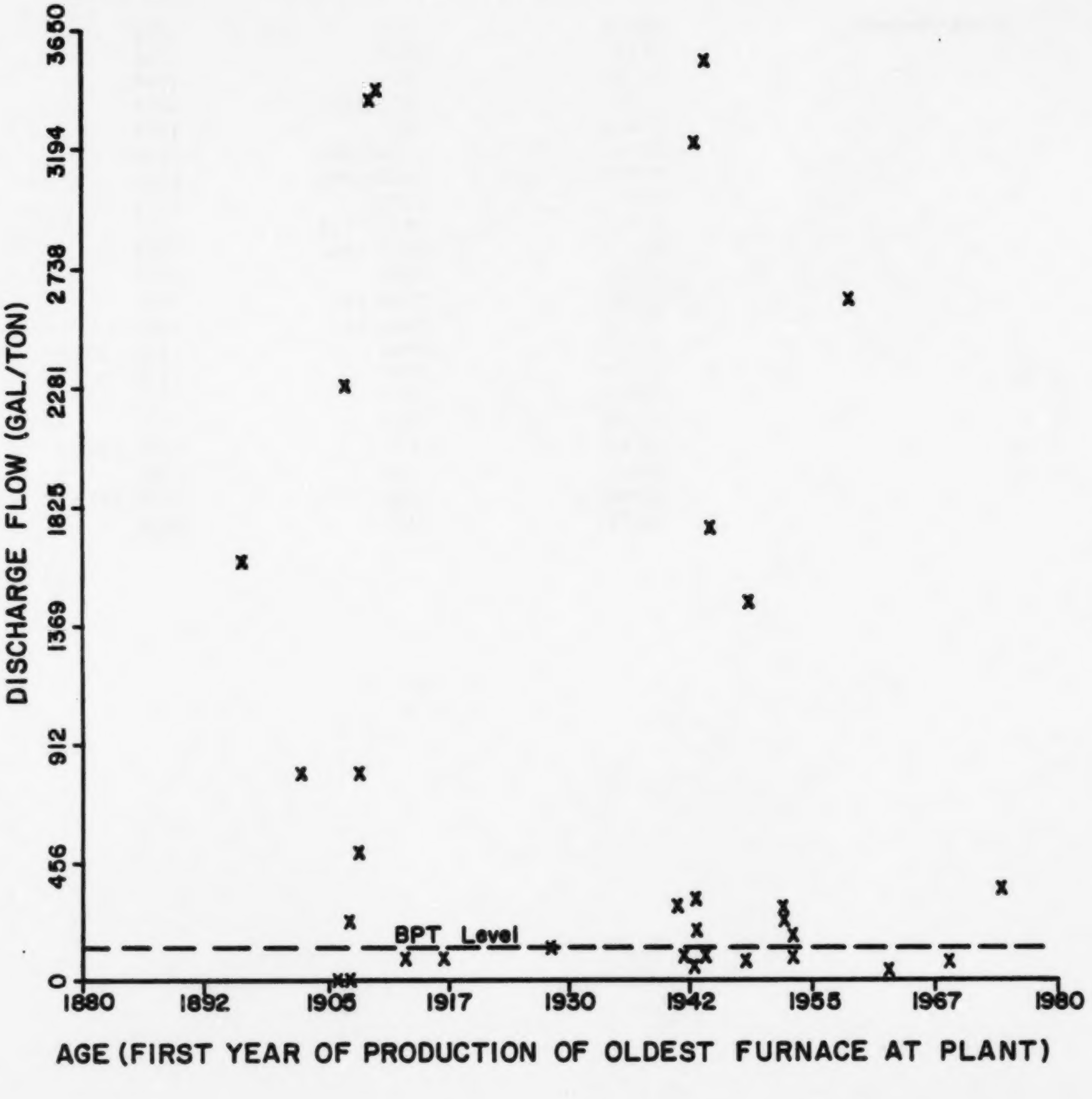
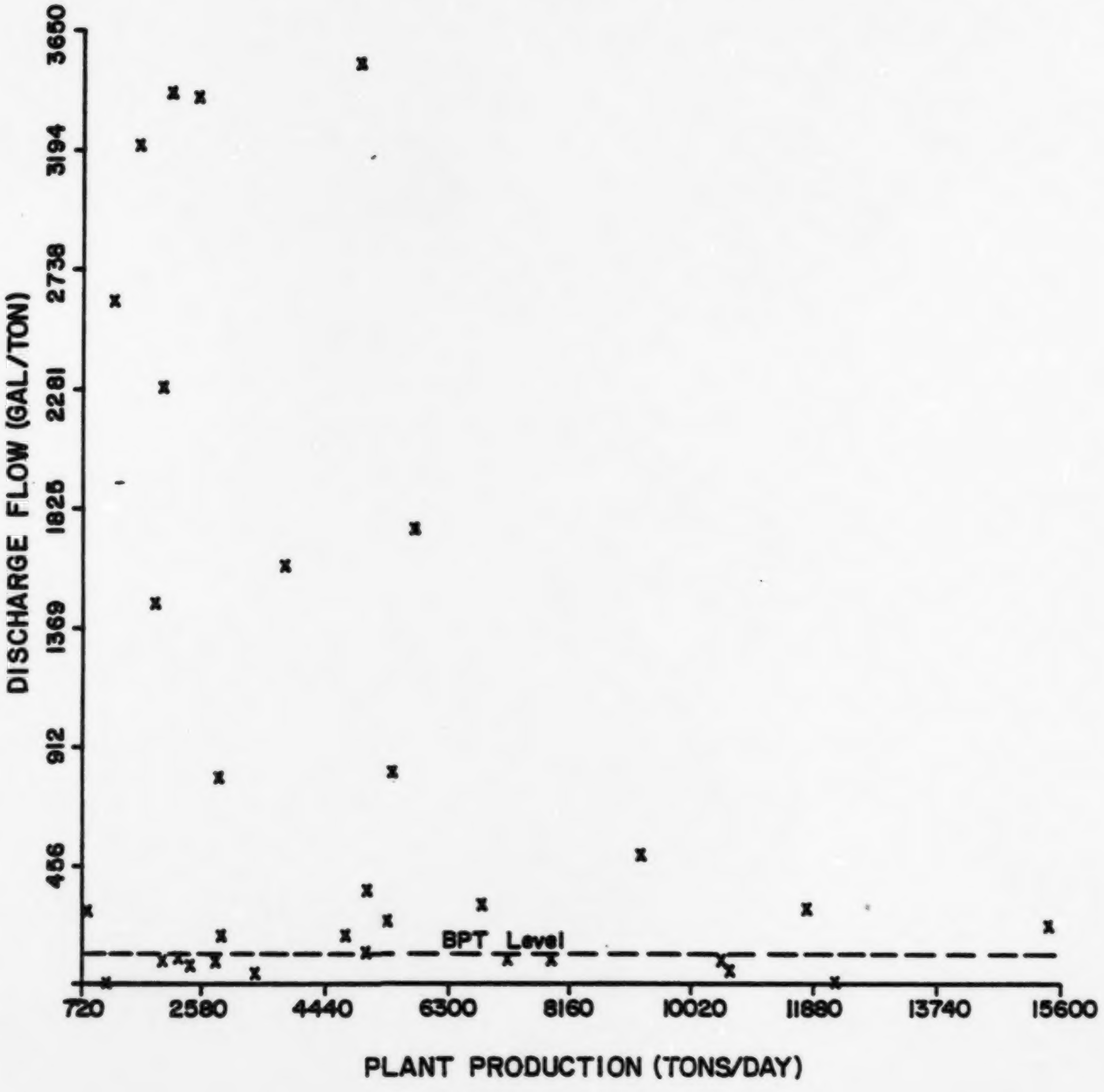


FIGURE IV-2

BLAST FURNACE-RECYCLING PLANTS



IRONMAKING SUBCATEGORY

SECTION V

WATER USE AND WASTEWATER CHARACTERIZATION

Introduction

This section presents data which characterize wastewater streams originating in blast furnace operations. These data were obtained during the field sampling programs conducted at one ferromanganese and eleven iron blast furnace operations. During the original sampling program the Agency measured the levels of the pollutants limited under the originally promulgated effluent guidelines. During the second field sampling program the levels of those pollutants were again measured, while additional monitoring was performed for toxic pollutants. To confirm and expand upon the toxic pollutant survey data, the Agency conducted sampling visits at three additional blast furnace sites (plants 0112, 0684F, and 0860H). The Agency included data from these visits in the existing data base. The Agency did not observe any significant differences in the basic character of the process wastewaters during these visits.

Description of the Ironmaking Operation and Wastewater Sources

The water use rates discussed below pertain only to process wastewaters, and do not include noncontact cooling or nonprocess waters. Process wastewater is defined as water which has come into direct contact with the process, products, exit gases, and raw materials associated with blast furnace operations. The wastewaters, thereby, become contaminated with the pollutants characteristic of the process. Noncontact cooling water is defined as that water used for cooling which does not come into direct contact with the processes, products, by-products, or raw materials. Nonprocess water is defined as that water which is used in nonprocess operations, such as for utility and maintenance requirements.

Water is used within the blast furnace operation for two purposes: (1) to cool the furnace, stoves, and ancillary facilities, and (2) to clean and cool the furnace top gases. Although blast furnace wastewaters are primarily the result of the gas cleaning and cooling processes, there are other wastewaters sources. During the plant visits, the Agency found additional wastewaters from a dekishing operation (plant 0432A), which treated these wastewaters with sintering wastewaters, and from a slag quench wastewater treatment operation (plant 0112D). Other miscellaneous waters, such as floor drains and drip legs, are also included as part of the process wastewaters, but, as mentioned above, the gas scrubber and cooler wastewater is the primary and most important wastewater.

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The industry provided process wastewater and treated effluent flow data in the DCP responses. In many instances these data were reported as measured values, but some were reported as best engineering judgment or design values. In most instances DCP flow data are presented in the summary table; however, where available, plant visit or D-DCP information was used in lieu of the DCP data. Plant process wastewater flows varied over a wide range (1034 to 6708 gal/ton) and, likewise, plant effluent flows also spanned a wide range (0 to 3902 gal/ton). This wide range in flows can be attributed to several factors, but scrubber design and efficiency, the number of scrubbers used, and gas cooling requirements generally are the principal factors influencing water usage. The effluent flow rates are primarily determined by the amount of recycle employed. There is no indication that the industry adjusts process water usage to meet reduced or increased production demands, except to the extent that such production changes affect the number of furnaces in operation at a given plant.

One method of conserving water and reducing the quantities of pollutants discharged is recycle. Recirculation of ironmaking wastewaters is currently practiced at about 90% of the plants and is a major component in the BPT model treatment system. Although recirculation may result in an increase in the concentration of certain dissolved inorganic pollutants in the recycled wastewater, the significant reduction in discharge flow which results from recycle reduces the total pollutant load discharged.

Blast furnace wastewaters contain suspended particulate matter, cyanide, phenols and ammonia; all of which are limited by current NPDES permits. Other wastewater pollutants include toxic metals and certain toxic organic pollutants which originate in the raw materials or are formed during the reduction process. The concentration data presented in Tables V-1 through V-4 provide a measure of the significant pollutants contributed during each pass through the process. After reviewing the data, the Agency determined that the effect of makeup water quality on these wastewaters is negligible. Accordingly, the effluent limitations and standards are based solely on gross values. Refer to Section VII for a further discussion regarding this issue.

TABLE V-1

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES SURVEY
IRON MAKING BLAST FURNACES

Pick-up per pass concentrations (mg/l) in raw process wastewaters

Reference Code Plant Code Sample Point(s) Flow, gal/ton	0946A L 1-(6+8) 5,400	0396A M 1-(2+4) 2,057	0448A N 1-(2+5) 3,350	0060F O 1-(4+5) 3,123	Average
pH (Units	6.6	7.1-8.3	6.6	7.4-7.5	6.6-8.3
Ammonia (as N)	1.19	2.70	7.98	10.1	5.49
Fluoride	0.15	1.3	2.24	-	0.92
Phenols (4AAP)	0.120	-	0.529	0.085	0.184
Suspended Solids	72	611	306	1,167	539
121 Cyanide (Total)	1.42	0.806	1.68	-	0.976

-: Calculation results in a negative value. Negative values were considered zero in the determination of the averages.

TABLE V-2

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
IRON MAKING BLAST FURNACES

Pick-up per pass concentrations (mg/l) in raw process wastewaters

	Reference Code	0196A	0112D	0432A	0684H		
	Plant Code	021	026	027	028		
	Sample Point(s)	(B-D)	(G+K)-(I+M+N)	(C-A)	B-(A+C)		Overall
	Flow, gal/ton	1280	1567	3091	2277	Average	Average(1)
	pH	8.4-8.9	6.4-7.1	9.2-9.7	6.9-12.1	6.4-12.1	6.4-12.1
	Ammonia (N)	20.4	16.3	17	10.4	16.0	10.8
	Fluoride	2.6	-	6.5	1.8	2.7	1.8
	Phenols (4AAP)	-	0.052	2.91	0.68	0.910	0.547
	Suspended Solids	3502	386	1610	1599	1774	1157
9	Hexachlorobenzene	0.155	ND	ND	ND	0.039	0.039
23	Chloroform	-	-	0.018	-	0.004	0.004
31	2,4-Dichlorophenol	ND	ND	ND	0.200	0.050	0.050
34	2,4-Dimethylphenol	ND	0.0	0.053	0.0	0.013	0.013
39	Fluoranthene	15.955	0.0	0.082	-	4.009	4.009
55	Naphthalene	0.014	0.012	ND	-	0.006	0.006
65	Phenol	2.135	ND	0.595	-	0.682	0.682
73	Benzo(a)pyrene	14.198	-	0.0	ND	3.550	3.550
76	Chrysene	0.420	0.015	0.0	ND	0.109	0.109
80	Fluorene	-	0.021	0.006	ND	0.007	0.007
84	Pyrene	15.104	0.003	0.053	-	3.790	3.790
114	Antimony	NA	NA	0.033	NA	0.033	0.033
115	Arsenic	NA	NA	0.044	NA	0.044	0.044
118	Cadmium	0.036	0.010	0.067	0.146	0.065	0.065
119	Chromium	0.040	0.046	0.067	0.628	0.195	0.195
120	Copper	0.099	-	0.112	1.14	0.338	0.338
121	Cyanide (Total)	15.8	0.008	12.0	0.080	6.97	3.97
122	Lead	53.5	0.096	4.67	23.2	20.4	20.4
124	Nickel	0.100	0.013	0.0	1.15	0.316	0.316
125	Selenium	NA	NA	0.061	NA	0.061	0.061
128	Zinc	59.9	4.55	19.9	29.7	28.5	28.5

- : Calculation results in a negative value. Negative values were considered zero in the determination of the averages.
NA: No analysis performed
ND: Not detected

(1) Average of all values on Tables V-1 and V-2.

TABLE V-3

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES SURVEY
FERROMANGANESE BLAST FURNACE

Pick-up per pass concentrations (mg/l) in raw process wastewaters

	Gas Scrubber	Gas Cooler
Reference Code	0112C	0112C
Plant Code	Q	Q
Sample Point(s)	2-(4+1)	5-4
Flow, gal/ton	2,233	5,705
pH (Units)	12.1-12.2	8.6-8.7
Ammonia (as N)	-	136
Manganese	2,946	5.41
Phenols (4AAP)	-	0.461
Suspended Solids	17,193	50
121 Cyanide (Total)	-	105

-: Calculation results in a negative value.

TABLE V-4

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
FERROMANGANESE BLAST FURNACE

Pick-up per pass concentrations (mg/l) in raw process wastewaters

Reference Code	0112C
Plant Code	025
Sample Points	(B+D) - (C+E)
Flow, gal/ton	11,540
Ammonia (as N)	25
Manganese	79
Phenols (4AAP)	0.142
Suspended Solids	3750
pH	8.8-11.3
4 Benzene	0.013
23 Chloroform	0.018
55 Naphthalene	0.015
85 Tetrachloroethylene	0.055
86 Toluene	0.010
115 Arsenic	1.74
117 Beryllium	0.003
119 Chromium	0.047
121 Cyanide (Total)	-
122 Lead	0.737
127 Thallium	0.045
128 Zinc	4.41

-: Calculation results in a negative value.

IRONMAKING SUBCATEGORY

SECTION VI

WASTEWATER POLLUTANTS

Introduction

This section presents the pollutants which the Agency determined to be characteristic of ironmaking process wastewaters, the rationale for their selection and the sources of these pollutants. First, a list of pollutants considered to be characteristic of ironmaking operations was developed based upon data gathered during the original guidelines survey and from the DCP responses. The Agency confirmed that the initial list of pollutants was appropriate and added other pollutants by reviewing monitoring data gathered during the toxic pollutant survey.

Conventional Pollutants

The originally promulgated BPT effluent limitations included limitations for total suspended solids and pH. The Agency selected total suspended solids because of the substantial quantities of particulates found in the ironmaking process wastewaters.

The Agency limited pH because it is a measure of the acidity or alkalinity of wastewater discharges. In addition to its direct adverse environmental impacts, extremes in pH can aggravate the adverse effects of other pollutants such as ammonia-N and cyanide, influence corrosion rates and affect process and wastewater treatment system operations. The pH of ironmaking process wastewaters is typically in the neutral to slightly alkaline range.

Nonconventional, Nontoxic Pollutants

In both iron and ferromanganese blast furnace operations, ammonia is present in the furnace exit gases and in furnace process wastewaters. Ammonia is present as a result of the various nitrogen compounds which are driven out of the coke charge during blast furnace operations. Fluoride is present in ironmaking process wastewaters as a result of the fluoride compounds, primarily calcium fluoride, present in the limestone charged to the furnace. The presence of manganese in ferromanganese blast furnace wastewaters is related to the type of ore used in ferromanganese furnace operations. Limitations for ammonia-N were included in the previous regulation.

Toxic Pollutants

Cyanide is generated in the reducing atmosphere of the furnace as a result of the reaction of nitrogen in the blast air with carbon from the coke charge. Larger quantities of cyanide are generated at the higher temperatures associated with ferromanganese furnaces. Phenolic compounds are driven out of the coke charge during blast furnace operation. Toxic phenolic pollutants were limited indirectly in the originally promulgated regulation by the limitations established for phenols (4AAP).

The Agency also considered other toxic pollutants found in blast furnace wastewaters. The Agency determined the pollutants existing in these process wastewaters on the basis of responses to the DCPs, and analyses performed during the screening phase of the project. Table VI-1 presents these pollutants.

The Agency evaluated relevant data regarding these pollutants and calculated net concentration values (reflecting the pollutant pickup through the process as described in Section V) for each pollutant detected in the raw process wastewaters. Those pollutants found at an average net concentration of less than 0.010 mg/l were excluded from further consideration. A list of pollutants, including the conventional and nonconventional pollutants, detected in the raw process wastewaters at net concentrations of 0.010 mg/l or greater are presented in Table VI-2.

The toxic metal pollutants detected in the process wastewaters originate in the raw materials (primarily the ores and sinter) charged to the furnaces. These pollutants are present in the blast furnace exit gases and contaminate the process wastewaters during scrubbing and cooling operations. The predominant toxic metal pollutants in ironmaking process wastewaters are lead and zinc. For details pertaining to the selection of pollutants considered for limitation, refer to Sections X through XIII.

Although several toxic organic pollutants are included in the list of pollutants presented in Table VI-1, Table VI-2 does not include all of these pollutants. The Agency excluded certain toxic organic pollutants from Table VI-2 (i.e., phthalates) because it believes that those pollutants are artifacts (i.e., resulting from sampling and laboratory procedures), which are unrelated to blast furnace operations. The presence of the remaining toxic organic pollutants is attributable to the raw materials charged (primarily, the coke charge). These pollutants can be controlled by limiting other pollutants.

Other pollutants (e.g., calcium, chloride) are present at substantial levels in the process wastewaters, but are not included in the list of selected pollutants since they are nontoxic in nature and difficult to remove. Treatment of these pollutants in wastewater discharges is not commonly practiced in any industry.

TABLE VI-1

TOXIC POLLUTANTS KNOWN TO BE PRESENT

	Iron Blast Furnaces
	Phenols(4AAP)
4	Benzene
9	Hexachlorobenzene
23	Chloroform
31	2,4-dichlorophenol
34	2,4-dimethylphenol
39	Fluoranthene
65	Phenol
73	Benzo(a)pyrene
76	Chrysene
84	Pyrene
85	Tetrachloroethylene
86	Toluene
114	Antimony
115	Arsenic
118	Cadmium
119	Chromium
120	Copper
121	Cyanide (Total)
122	Lead
124	Nickel
125	Selenium
128	Zinc

	Ferromanganese Blast Furnaces
	Phenols(4AAP)
4	Benzene
23	Chloroform
55	Naphthalene
65	Phenol
85	Tetrachloroethylene
86	Toluene
115	Arsenic
117	Beryllium
119	Chromium
121	Cyanide (Total)
122	Lead
127	Thallium
128	Zinc

TABLE VI-2

SELECTED POLLUTANTS

Iron Blast Furnaces

	pH
	Ammonia (as N)
	Fluoride
	Phenols (4AAP)
	Suspended Solids
9	Hexachlorobenzene
31	2,4-Dichlorophenol
34	2,4-Dimethylphenol
39	Fluoranthene
65	Phenol
73	Benzo(a)pyrene
76	Chrysene
84	Pyrene
114	Antimony
115	Arsenic
118	Cadmium
119	Chromium
120	Copper
121	Cyanide (Total)
122	Lead
124	Nickel
125	Selenium
128	Zinc

Ferromanganese Blast Furnaces

	pH
	Ammonia (as N)
	Manganese
	Phenols (4AAP)
	Suspended Solids
4	Benzene
23	Chloroform
55	Naphthalene
85	Tetrachloroethylene
86	Toluene
115	Arsenic
117	Beryllium
119	Chromium
121	Cyanide (Total)
122	Lead
127	Thallium
128	Zinc

IRONMAKING SUBCATEGORY

SECTION VII

CONTROL AND TREATMENT TECHNOLOGY

Introduction

A review of the control and treatment technologies currently in use or available for use for ironmaking operations provided the basis for the selection and development of the BPT, BAT, NSPS, PSES and PSNS alternative treatment systems. DCP, D-DCP, and plant visit data were reviewed to identify those treatment components and systems currently in use. Treatment capabilities, either demonstrated in this or in other subcategories (refer to Volume I), were used by the Agency in evaluating the various model wastewater treatment technologies. However, only well demonstrated technologies were used to develop effluent limitations and standards for ironmaking operations.

This section also presents the raw wastewater and treated effluent monitoring data from sampled plants, pilot plant studies, and the monitoring data provided by the industry through D-DCP responses and responses to supplemental questionaires issued in response to public comments on the proposed regulation. This section also presents descriptions of treatment systems at each of the sampled plants and examines, in detail, the effect of make-up water quality on raw waste loadings.

Control and Treatment Technologies

As noted earlier, ironmaking wastewaters result primarily from furnace top gas cleaning and cooling. Other wastewater sources may be included; however, these sources comprise only a minor portion of the total pollutant load. Although the typical ironmaking wastewater treatment systems were initially designed for the removal of particulate matter only, other pollutants, (i.e., ammonia, cyanide and phenols) are present in these wastewaters and require treatment. Following is a summary of actual treatment practices as determined by the Agency through plant visits and DCP responses (refer to Tables III-1 and III-2).

a. The initial step in the treatment of ironmaking wastewaters is the removal of suspended solids. All of the plants use a thickener (or similar gravity sedimentation component) to remove suspended solids from process wastewaters. The technology also partially removes other pollutants which are entrained in the suspended solids (e.g., the toxic metals).

b. The slurry from the bottom of the thickener is dewatered by various devices. Vacuum filters are used at most plants for this purpose.

c. In order to improve solids removal performance in the thickeners, coagulant aids such as polymers and ferric chloride are added to the wastewater stream at the thickener inlet. These coagulant aids enhance solids removal by aiding in the formation of larger, more readily settleable particles. This technology also results in a certain degree of toxic pollutant removal as pollutants entrained in the solids are removed. Coagulant aids are used at over three-fourths of the plants.

d. At five plants, the thickener/clarifier overflow is reused elsewhere. One method of reuse involves the mixing of the thickener effluent with incoming fresh water for use in various process or cooling applications throughout the plant, as well as for makeup to the blast furnace gas cleaning and cooling systems. In these operations, the reused water is discharged at various points throughout the plant. Reuse of the effluent in the plant water system results in the dilution of the wastewater and does not result in the removal of the pollutants contained in the wastewater.

e. In order to conserve water and to reduce effluent waste loads, most plants employ systems in which a large portion of the process wastewater is recycled. Recycle is now practiced or will shortly be practiced at about 90% of the plants. In the basic recycle system, the thickener effluent is recirculated through a cooling tower to the gas cleaning and cooling operations. The wastewater discharge in these instances consists of a blowdown from the thickener effluent or from the cooling tower effluent. As noted above, the sludge which settles in the thickener is dewatered by a vacuum filter and the filtrate is returned to the thickener influent. In treatment and recycle operations, flocculation, sedimentation and recycle provide the most significant means of pollutant load reduction, although some oxidation and air stripping may occur in the cooling tower.

f. Chlorination is used at several plants to reduce cyanide and phenol levels. At one plant, the thickener influent is chlorinated and discharged without recycle. At another plant, the thickener effluent is recycled after passage through a cyanide destruction system (alkaline chlorination). Both of these plants were sampled during this study, and the latter plant exhibited the capability to significantly reduce the levels of ammonia, cyanide, and phenol. Alkaline chlorination systems have been installed at several plants to treat recycle system blowdowns.

g. The blowdowns from two recycle systems are discharged to POTWs.

h. The blowdowns from recirculation systems at five plants are used to quench slag or coke, or are evaporated in BOF hoods. This treatment arrangement, under careful control, can eliminate the discharge of pollutants into receiving waters.

Control and Treatment Technologies for BAT, NSPS, PSES and PSNS

Several toxic pollutants were found in the treated effluents of the sampled plants at concentrations greater than 0.5 mg/l. Because of high discharge levels and pass through of pollutants at POTWs, the Agency has promulgated BAT limitations and NSPS, PSES, and PSNS for these toxic pollutants. The effluent limitations and standards are based upon the application levels of treatment beyond that for BPT. A description of the treatment technologies considered by the Agency for BAT, NSPS, PSES and PSNS is set out below.

Filtration

Filtration is a common and effective method of removing suspended solids and those pollutants (particularly the toxic metals) which are entrained in these solids. Filtration can be used as the last major component in a treatment system or may be used to provide pretreatment prior to another component (such as an activated carbon system). Generally, the filter bed is comprised of one or more filter media (e.g., sand, anthracite, garnet) and a variety of filtration systems are available (flat bed, deep bed, pressure or gravity). As noted above, filtration can be used to reduce the discharge of certain insoluble toxic pollutants (the non-dissolved toxic metals). However, other toxic pollutants, such as ammonia-n, cyanide and phenols, will not be removed from the process wastewaters by this technology. Filtration is used in a wide variety of steel industry applications, including three central treatment facilities (one was sampled) which treat ironmaking wastewaters.

Toxic Metals Removal Using Sulfide Precipitation

Sulfide precipitation has been shown to be capable of reducing effluent toxic metals concentrations substantially below the levels achieved in lime flocculation and precipitation systems. Some of the toxic metals which can effectively be precipitated with sulfide are zinc, copper, nickel and lead. The increased removal efficiencies can be attributed to the comparative solubilities of metal sulfides and metal hydroxides. In general, the metal sulfides are less soluble than the respective metal hydroxides. However, an excess of sulfide in a treated effluent can result in objectionable odor problems. A decrease in wastewater pH will aggravate this problem, and if wastewater treatment pH control problems result in even a slightly acidic pH, operating personnel can be affected. One method of controlling the presence of excess sulfide in the treated effluent involves feeding an iron sulfide slurry. Ferrous sulfide will not readily dissociate in the waste stream, ensuring that the free sulfide level is kept below objectionable levels. However, the affinities of the other metals in the waste stream for sulfide are greater than that of iron, which causes other metal sulfide precipitates to form preferentially to iron sulfide. Once the sulfide requirements of the other metal precipitates are satisfied, sulfide remains as a ferrous precipitate and the excess iron from the sulfide is precipitated as a hydroxide. With the use of filtration following sulfide addition, significant toxic metals load reductions can be achieved. Sulfide precipitation is not used for the treatment of BPT effluents in the ironmaking subcategory.

Alkaline Chlorination

Certain nonconventional and toxic pollutants are amenable to treatment by oxidation reactions. Because it is well demonstrated on a full scale basis within the ironmaking subcategory, the Agency considered two-stage alkaline chlorination as an alternative treatment technology at the BAT, NSPS, PSES and PSNS levels of treatment. Alkaline chlorination involves the addition of chlorine (a strong oxidizing agent) to process wastewaters which already are, or which have been adjusted, to an alkaline pH. Chlorine addition is typically accomplished by the eduction of the gas into a pumped wastewater sidestream which is returned to the treatment process, or by the addition of a liquid such as sodium hypochlorite to the wastewaters. The oxidation reduction potential (ORP) of the wastewaters being treated is measured during treatment to monitor and control the alkaline chlorination treatment process.

Two-stage alkaline chlorination is used primarily to destroy, ammonia, cyanide, phenols, and other toxic organic pollutants. The end-products of the cyanide destruction reactions are CO_2 and N_2. The end-products of the oxidation of ammonia are principally N_2 and H_2O, while the end-product of phenols oxidation is CO_2.

While alkaline chlorination is an effective means of removing ammonia, cyanide, and phenols, it can produce toxic organic compounds at undesirable levels. These compounds, primarily halomethanes, are by-products of the reaction between chlorine and certain constituents (precursors) in the ironmaking wastewaters. Studies conducted by both the Agency and industry on blast furnace wastewaters treated by alkaline chlorination show varying levels of halomethane formation. The data indicate that formation of halomethanes is largely dependent upon the treatment configuration and the presence of precursors (measured as suspended solids). Where adequate suspended solids removal is achieved prior to chlorination, the total halomethane concentration found in the chlorinated effluent is held to levels of about 0.1 mg/l (the drinking water standard for trihalomethanes). Studies performed at potable water treatment plants resulted in similar findings.

Monitoring conducted at Plant 0432A, where alkaline chlorination was practiced on blast furnace wastewaters after suspended solids removal, showed that only low levels (0.05 mg/l) of chloroform were formed. No other halomethanes were detected. Data from a pilot plant study conducted by U.S. Steel at Plant 0860B, indicate less than 0.1 mg/l of total halomethanes in the chlorinated effluent (Table VII-8). The pilot facility included pH adjustment and clarification prior to chlorination. Data for full scale operation of the treatment facility are similar to the pilot scale data. Pilot studies were also conducted by Metcalf & Eddy, Inc, for EPA using single-stage and two-stage alkaline chlorination systems, with and without air stripping. These studies again demonstrated that the system with suspended solids removal preceding chlorination had the lowest level of halomethane formation (total halomethane of 0.2 mg/l and trihalomethane of 0.06 mg/l). This system also included air stripping of the wastewater prior to the addition of chlorine. Air stripping, however, is not expected to have a significant effect on the presence of precursors, since studies conducted at water treatment facilities indicate that aeration prior to chlorination has no effect on halomethane formation. Considering the available data, the Agency believes that alkaline chlorination of ironmaking and sintering wastewater preceded by removal of suspended solids will result in the formation of only low levels of halomethanes while substantial quantities of ammonia, cyanide, and phenols (4AAP) will be removed.

Dechlorination

To minimize the potential toxicity of wastewaters which have been chlorinated, the Agency considered dechlorination to reduce total residual chlorine levels in the treated discharge. Dechlorination is practiced on a full scale basis at plant 0584C for a central treatment facility which includes sintering and ironmaking wastewaters. This technology is also widely practiced in the electric power generation and electroplating industries. Reducing agents, such as sulfites or sulfur dioxide, are added to the chlorinated effluent in sufficient quantities to react with the excess residual chlorine, thereby forming nontoxic chlorides.

Removal of Organics With Activated Carbon

Adsorption with activated carbon is widely used for the removal of organic pollutants from wastewaters. This technology is used to reduce the concentrations of oxygen demanding substances in POTW effluents. This technology is also used to remove organic pollutants in industrial wastewaters including those from petroleum refining, organic chemical manufacturing and cokemaking. It should be noted that several toxic organic pollutants found in ironmaking wastewaters are also found in cokemaking wastewaters. This can be attributed to the use of coke in the ironmaking process. Activated carbon is installed on a full scale basis for the treatment of ironmaking and sintering wastewaters at Plant 0860B.

Operating guidelines for the use of activated carbon specify that when combined wastewater streams are being treated or where the wastewater to be treated has significant turbidity, clarification or filtration is necessary to achieve optimum treatment efficiency. The use of chemical precipitation and diatomaceous earth filtration may be necessary to achieve the clarity required for the removal of the toxic organic pollutants which may be present at low levels. Suspended solids control is also necessary because particulates in water can adsorb organic pollutants, and then release the organics after passing through the carbon bed.

Laboratory tests performed on single compound systems indicate that processing with activated carbon may achieve residual levels on the order of 1 microgram per liter for many of the toxic organic pollutants. The Agency believes that the following compounds (among others) respond well to adsorption: carbon tetrachloride, chlorinated benzenes, chlorinated ethanes, chlorinated phenols, haloethers, phenols, nitrophenols, DDT and metabolites, pesticides, polynuclear aromatics and PCBs.

The pH of the wastewater to be treated must be controlled within the range 6-8 to minimize dissociation of both acid and basic compounds. Generally, normal pH variations within the neutral range will not significantly affect the operation of activated carbon systems.

Vapor Compression Distillation

Vapor compression distillation is a process which can be used to achieve zero discharge. In this process, the wastewaters are evaporated resulting in the concentration of non-volatile pollutants and other constituents in the wastewater to slurry consistency. The steam distillate leaving the system is condensed and recycled back to the production process for resue. The slurry discharge can be dried in a mechanical drier or allowed to crystallize in a small solar or steam-heated pond prior to final disposal. One desirable feature of the process is its relative freedom from scaling. Because of the unique design of the system, calcium sulfate and silicate crystals grow in solution as opposed to depositing on heat transfer surfaces. Economic operation requires a high calcium to sodium ratio (hard waters).

Plant Visit Data

Table VII-1 provides a legend for the various control and treatment technology abbreviations used in various tables throughout this report. Table VII-2 presents a summary of raw wastewater and effluent data for the iron blast furnaces visited in conjunction with the original guidelines survey. Table VII-3 presents a summary of all iron blast furnace raw wastewater data collected during the toxic pollutant survey, and Table VII-4 presents a summary of the respective effluent data. Table VII-5 presents a summary of raw wastewater and effluent data from a ferromanganese blast furnace visited during the original guidelines survey. Table VII-6 presents a summary of ferromanganese raw wastewater and effluent data obtained during the toxic pollutant survey.

Table VII-7 presents a summary of the effluent data provided in the D-DCPs. Tables VII-8 and VII-9 present summaries of pilot plant data from plant 0860B. Table VII-10 presents a summary of long-term effluent data for the recycle system blowdown at plant 0860B. This recycle system is the same as the BPT treatment model system. Table VII-11 presents a summary of effluent data from the full-scale alkaline chlorination/activated carbon treatment system in use at plant 0860B.

Plant Visits

Iron Blast Furnaces

Following are summaries of the treatment in place at eight iron blast furnaces visited during the original guidelines and toxic pollutant surveys. Plant schematics are found at the end of this section.

Plant L (0946A) - Figure VII-1

Blast furnace gas cleaning system wastewaters are combined with sinter plant wastewaters and treated by sedimentation in a thickener, followed by alkaline chlorination, filtration and recycle with the blowdown being discharged to a receiving stream.

Plant M (0396A) - Figure VII-2

Blast furnace gas cleaning system wastewaters are treated by sedimentation in a thickener, evaporative cooling and recycle. A portion of the thickener overflow is discharged to a POTW while most of the overflow is passed through a cooling tower and recycled.

Plant N (0448A) - Figure VII-3

Blast furnace gas cleaning wastewaters are treated by sedimentation in a thickener, evaporative cooling and recycle. The blowdown is completely evaporated by slag and in coke quenching, and BOF hood sprays. There is no wastewater discharge to receiving waters.

Plant O (0060F) - Figure VII-4

Blast furnace gas cleaning system wastewaters are treated by sedimentation in a thickener, evaporative cooling, and recycle. An electrostatic precipitator is used following the venturi scrubbers and gas cooler. The blowdown is completely evaporated by slag and coke quenching, and in BOF hood sprays. There is no wastewater discharge to a receiving stream.

Plant 021 (Confidential)

Wastewaters from individual blast furnace scrubbing systems are combined and treated by sedimentation in a thickener, acid addition for pH adjustment, evaporative cooling and recycle. A portion of the recycle water is blown down. The blowdown is combined with other plant wastewaters and treated further at a central treatment facility.

Plant 026 (0112D) - Figure VII-5

Blast furnace gas cleaning system wastewaters are combined with slag pit quench wastewaters and treated by pH adjustment with acid, coagulation with polymer, sedimentation in a thickener, evaporative cooling and recycle. A portion of the recycle water is blown down to a central treatment facility which receives wastewaters from several steelmaking and forming and finishing operations.

Plant 027 (0432A) - Figure VII-6

Blast furnace gas cleaning, sintering, and dekishing wastewaters are combined in a central treatment facility which includes sedimentation in a thickener, and alkaline chlorination. The effluent from the once-through treatment system is discharged to a receiving stream.

Plant 028 (0684H) - Figure VII-7

Blast furnace gas cleaning system wastewaters are treated by aeration, pH adjustment with lime, chlorination, coagulation with polymer, sedimentation in a thickener, evaporative cooling and recycle. A portion of the recycle water is blowndown to a POTW.

Ferromanganese Blast Furnace

Ferromanganese blast furnace operations are similar to iron blast furnace operations as top gases are cleaned using the same types of wet scrubbers. However, major differences between iron and ferromanganese furnaces with respect to raw materials and furnace operating temperatures result in differences in process wastewater quality. Ferromanganese furnaces produce higher levels of cyanide and manganese.

Information on ferromanganese furnaces is limited because, historically only a few furnaces in the U.S. have produced ferromanganese. In fact, at the time of this study only one furnace was operational. Recently this remaining furnace was shut down and is not expected to renew operations in the forseeable future.

During the course of the original guidelines and toxic pollutant surveys, this particular ferromanganese operation was surveyed twice. The operation was sampled a second time because its wastewater treatment system had been upgraded since the first visit. The result of this upgrading was that the operation ceased discharging pollutants to the receiving stream. Approximately 90 gal/ton of wastewater left the system with the filter cake which was transported to a landfill for disposal.

A brief description of this plant under the two different treatment approaches is provided below:

Plant Q (0112C) - Figure VII-8

Venturi scrubber wastewater treatment included sedimentation in a thickener and complete recycle to the scrubbers. Gas cooler wastewaters were discharged to a receiving stream without treatment.

Plant 025 (0112C) - Figure VII-9

Venturi scrubber wastewater treatment included sedimentation in a thickener and complete recycle to the scrubbers. Gas cooler wastewater treatment included sedimentation in a thickener with the thickener effluent being completly recycled to the coolers. This plant had no wastewater discharge to a receiving stream.

Effect of Make-up Water Quality

Where the mass loading of a limited pollutant in the make-up water to a process is small in relation to the raw waste loading of that pollutant, the impact of make-up water quality on wastewater treatment system performance is not significant, and, in many cases, not measurable. In these instances, the Agency has determined that the respective effluent limitations and standards should be developed and applied on a gross basis.

Table VII-12 presents an analysis of the effect of make-up water quality on the raw waste loadings of each pollutant limited in the regulation for the ironmaking subcategory. These data were obtained from blast furnace sampling surveys completed for this study. The analysis clearly demonstrates that the levels of the limited pollutants in the intake waters are not significant compared to raw waste loadings. The intake waters added less than one percent to the raw waste loadings of each limited pollutant. Thus the Agency has determined that the limitations and standards should be applied on a gross basis, except to the extent provided by 40 CFR 122.63(h).

TABLE VII-1

OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS

Symbols

A. Operating Modes

1. OT Once-Through

2. Rt,s,n Recycle, where t = type waste
s = stream recycled
n = % recycled

t: U = Untreated
T = Treated

	s	n
P	Process Wastewater	% of raw waste flow
F	Flume Only	% of raw waste flow
S	Flume and Sprays	% of raw waste flow
FC	Final Cooler	% of FC flow
BC	Barometric Cond.	% of BC flow
VS	Abs. Vent Scrub.	% of VS flow
FH	Fume Hood Scrub.	% of FH flow

3. REt,n Reuse, where t = type
n = % of raw waste flow

t: U = before treatment
T = after treatment

4. BDn Blowdown, where n = discharge as % of raw waste flow

B. Control Technology

10. DI Deionization

11. SR Spray/Fog Rinse

12. CC Countercurrent Rinse

13. DR Drag-out Recovery

C. Disposal Methods

20. H Haul Off-Site

21. DW Deep Well Injection

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT
TECHNOLOGIES AND DISPOSAL METHODS
PAGE 2

C. Disposal Methods (cont.)

22.	Qt,d	Coke Quenching, where t = type d = discharge as % of makeup t: DW = Dirty Water CW = Clean Water
23.	EME	Evaporation, Multiple Effect
24.	ES	Evaporation on Slag
25.	EVC	Evaporation, Vapor Compression Distillation

D. Treatment Technology

30.	SC	Segregated Collection
31.	E	Equalization/Blending
32.	Scr	Screening
33.	OB	Oil Collecting Baffle
34.	SS	Surface Skimming (oil, etc.)
35.	PSP	Primary Scale Pit
36.	SSP	Secondary Scale Pit
37.	EB	Emulsion Breaking
38.	A	Acidification
39.	AO	Air Oxidation
40.	GF	Gas Flotation
41.	M	Mixing
42.	Nt	Neutralization, where t = type t: L = Lime C = Caustic A = Acid W = Wastes O = Other, footnote

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT
TECHNOLOGIES AND DISPOSAL METHODS
PAGE 3

D. Treatment Technology (cont.)

43.	FLt	Flocculation, where t = type t: L = Lime A = Alum P = Polymer M = Magnetic O = Other, footnote
44.	CY	Cyclone/Centrifuge/Classifier
44a.	DT	Drag Tank
45.	CL	Clarifier
46.	T	Thickener
47.	TP	Tube/Plate Settler
48.	SLn	Settling Lagoon, where n = days of retention time
49.	BL	Bottom Liner
50.	VF	Vacuum Filtration (of e.g., CL, T> or TP underflows)
51.	Ft,m,h	Filtration, where t = type m = media h = head

t	m	h
D = Deep Bed	S = Sand	G = Gravity
F = Flat Bed	O = Other, footnote	P = Pressure

52.	CLt	Chlorination, where t = type t: A = Alkaline B = Breakpoint
53.	CO	Chemical Oxidation (other than CLA or CLB)

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS
PAGE 4

D. Treatment Technology (cont.)

54.	BOt	Biological Oxidation, where t = type t: An = Activated Sludge n = No. of Stages T = Trickling Filter B = Biodisc O = Other, footnote
55.	CR	Chemical Reduction (e.g., chromium)
56.	DP	Dephenolizer
57.	ASt	Ammonia Stripping, where t = type t: F = Free L = Lime C = Caustic
58.	APt	Ammonia Product, where t = type t: S = Sulfate N = Nitric Acid A = Anhydrous P = Phosphate H = Hydroxide O = Other, footnote
59.	DSt	Desulfurization, where t = type t: Q = Qualifying N = Nonqualifying
60.	CT	Cooling Tower
61.	AR	Acid Regeneration
62.	AU	Acid Recovery and Reuse
63.	ACt	Activated Carbon, where t = type t: P = Powdered G = Granular
64.	IX	Ion Exchange
65.	RO	Reverse Osmosis
66.	D	Distillation

TABLE VII-1
OPERATING MODES, CONTROL AND TREATMENT TECHNOLOGIES AND DISPOSAL METHODS
PAGE 5

D. Treatment Technology (cont.)

67.	AA1	Activated Alumina
68.	OZ	Ozonation
69.	UV	Ultraviolet Radiation
70.	CNTt,n	Central Treatment, where t = type n = process flow as % of total flow t: 1 = Same Subcats. 2 = Similar Subcats. 3 = Synergistic Subcats. 4 = Cooling Water 5 = Incompatible Subcats.
71.	On	Other, where n = Footnote number
72.	SB	Settling Basin
73.	AE	Aeration
74.	PS	Precipitation with Sulfide

TABLE VII-2

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES SURVEY
IRON MAKING BLAST FURNACES

Raw Wastewaters

Reference No.	0946A		0396A		0448A		0060F			
Plant Code:	L		M		N		O			
Sample Point(s)	1		1		1		1		Average	
Flow, gal/ton	5400		2057		3350		3123		3482	
	mg/l	lbs/1000 lb	mg/l	lbs/1000 lb	mg/l	lbs/1000 lb	mg/l	lbs/1000 lb	mg/l	lbs/1000 lb
pH (Units)	6.6		7.1-8.3		6.6-6.7		7.4-7.5		6.6-8.3	
Ammonia (N)	1.91	0.0430	63.2	0.542	227	3.17	85.5	1.11	94.4	1.22
Fluoride	0.64	0.0144	23	0.197	12.7	0.177	17.7	0.231	13.5	0.155
Phenols (4AAP)	0.132	0.00297	2.77	0.0238	0.564	0.00788	0.095	0.00124	0.890	0.00897
Suspended Solids	81	1.82	693	5.94	346	4.83	1209	15.7	582	7.07
121 Cyanide (T)	1.43	0.0320	16.9	0.145	18.5	0.258	9.67	0.126	11.6	0.140

Effluents

Sample Point(s)	(3/3+7) 6		2+3		2		4	
Flow, gal/ton	3391		123		101		104	
C&TT	T,CLA,SS,FP, RTP 37		T,CT, RTP 94		T,CT,SL,ES, RTP 97		T,FLP,CT, RTP 97,ES	
	mg/l	lbs/1000 lb	mg/l	lbs/1000 lb	mg/l	lbs/1000 lb	mg/l	lb/1000 lb
pH (Units)	7.6		Unable to determine accurately, as a major portion of the system discharge is a sludge blowdown to the sinter plant		6.7-8.1		8.0	
Ammonia (N)	0.806	0.0186			225	0.0948	82.2	0.0356
Fluoride	0.68	0.0116			10.7	0.00451	22	0.00954
Phenols (4AAP)	0.014	0.000363			0.035	0.000015	0.010	0.000004
Suspended Solids	3	0.0372			39	0.0164	46	0.0199
121 Cyanide (T)	0.005	0.000173			17.3	0.00729	10.8	0.00468

NOTE: For a definition of C&TT codes, refer to Table VII-1.

TABLE VII-3

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
IRON MAKING BLAST FURNACES

RAW WASTEWATERS															
Reference No.	0196A		0112D		0432A		0684H		0112	0684F	0860H				
Plant Code	021		026		027		028		030	029	024				
Sample Point(s)	B		G+K-I-N		C		B		-	-	-	Average		Overal[illegible]) Average	
Flow, gal/ton	1,280		1,567		3,091		2,277		N/A	N/A	N/A				
	mg/l	lbs/ 1000 lbs	mg/l	lbs/ 1000 lbs	mg/l	lbs/ 1000 lbs	mg/l	lbs/ 1000 lbs	mg/l	mg/l	mg/l	mg/l	lbs/ 1000 lbs	mg/l	lbs/ 1000 lbs
pH (Units)	8.4-8.9		6.4-7.1		9.2-9.7		6.9-12.1		7.1	NA	8.3	6.4-12.1		6.4-12.1	
Ammonia (N)	62.5	0.334	57.9	0.378	18	0.232	25	0.237	159	NA	23.6	57.6	0.295	72.4	0.756
Fluoride	152	0.811	15.2	0.0993	6.7	0.0864	9	0.0855	12	NA	76	45.2	0.271	32.5	0.213
Phenols (4AAP)	7.41	0.0396	0.080	0.000523	3.02	0.0389	2.50	0.0237	1.52	NA	0.083	2.44	0.0257	1.82	0.0173
Suspended Solids	3560	19.0	454	2.97	1643	21.2	1640	15.6	263	NA	429	1332	14.7	1032	10.9
9 Hexachlorobenzene	0.155	0.000827	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.022	0.000207	0.022	0.000207
31 2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	0.240	0.00228	ND	ND	ND	0.034	0.000570	0.034	0.000570
34 2,4-Dimethylphenol	ND	ND	0.0	0.0	0.053	0.000683	0.0	0.0	0.0	0.0	ND	0.008	0.000171	0.008	0.000171
39 Fluoranthene	16.100	0.0859	0.0	0.0	0.082	0.00106	ND	ND	0.022	0.0	0.0	2.31	0.0217	2.31	0.0217
65 Phenol	4.000	0.0214	ND	ND	0.637	0.00821	0.247	0.00235	0.130	ND	ND	0.716	0.00799	0.716	0.00799
73 Benzo(a)pyrene	14.198	0.0758	0.0	0.0	0.0	0.0	ND	ND	0.0	0.0	0.0	2.028	0.0190	2.028	0.0190
76 Chrysene	0.462	0.00247	0.015	0.000098	0.0	0.0	ND	ND	0.010	0.0	0.0	0.070	0.000642	0.070	0.000642
84 Pyrene	15.140	0.0808	0.003	0.000020	0.053	0.000683	ND	ND	0.018	0.0	0.0	2.17	0.0204	2.17	0.0204
114 Antimony	NA	NA	NA	NA	0.037	0.000477	NA	NA	0.0	0.010	0.008	0.014	0.000477	0.014	0.000477
115 Arsenic	NA	NA	NA	NA	0.046	0.000593	NA	NA	0.491	0.015	0.046	0.150	0.000593	0.150	0.000593
118 Cadmium	0.040	0.000214	0.001	0.000007	0.067	0.000864	0.153	0.00145	1.11	0.011	0.025	0.201	0.000634	0.201	0.000634
119 Chromium	0.090	0.000480	0.070	0.000457	0.160	0.00206	0.633	0.00601	0.869	0.045	0.121	0.284	0.00225	0.284	0.00225
120 Copper	0.30	0.00160	0.012	0.000078	0.120	0.00155	1.17	0.0111	0.997	0.059	0.085	0.392	0.00358	0.392	0.00358
121 Cyanide (Total)	41.5	0.222	0.054	0.000353	12.1	0.156	0.301	0.00286	43.4	NA	2.15	16.6	0.0953	14.6	0.118
122 Lead	55.0	0.294	1.05	0.00686	4.67	0.0602	23.3	0.221	2.50	0.508	0.895	47.9	0.146	47.9	0.146
124 Nickel	0.20	0.00107	0.013	0.000085	0.0	0.0	1.20	0.0114	2.45	0.192	0.597	0.665	0.00314	0.665	0.00314
125 Selenium	NA	NA	NA	NA	0.063	0.000812	NA	NA	0.035	0.0	0.001	0.025	0.000812	0.025	0.000812
128 Zinc	85.0	0.454	5.94	0.0388	20.0	0.258	30.0	0.285	1420	1.06	1.82	223	0.259	223	0.259

ND : Not detected
NA : No analysis performed
N/A: Not available

(1) Average of all raw wastewater values on Tables VII-2 and VII-3.

TABLE VII-4

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
IRON MAKING BLAST FURNACES

Effluents

Reference No.	0196A(1)		0112D		0432A		0684H		0112		0684F	0860H
Plant Code	021		026		027		028		030		029	024
Sample Point(s)	D+E		(G+K-I-M/G+K)H		C/(B+C+D+E) F		C		-		-	-
Flow, gal/ton	88		73		3091		188		76		N/A	N/A
C&TT	CL,NA,VF,CT,RTP-93		T,FLP,VF,NA,CT,RTP-97		PSP,FLP,T,CLA,OT		A,CLA,FLP,CL,CT, FLFC,NA,RTP-92		T,FLP,NA,VF,CT, RTP		PSP,Scr,FLP, FLFC,CL,SS,NA, VF,CT,RTP	PSP,Scr,FLP,CL T,VF,CT, RTP,ES
	mg/l	lbs/ 1000 lbs	mg/l	lbs/ 1000 lbs	mg/l	lbs/ 1000 lbs	mg/l	lbs/ 1000 lbs	mg/l	lbs/ 1000 lbs	mg/l	mg/l
pH (Units)	8.6-10.8		7.3-7.5		10.1-10.9		8.2-8.8		7.2-7.5		NA	8.3
Ammonia (N)	43.0	0.0158	40	0.0122	20	ISD	16	0.0125	138	0.0437	NA	25.1
Fluoride	148	0.0543	16	0.00474	3.2	0.415	7.9	0.00619	8.6	0.00273	NA	76
Phenols (4AAP)	7.36	0.00270	0.027	0.000008	2.86	0.0393	2.00	0.00157	0.207	0.000066	NA	0.019
Suspended Solids	92	0.0338	65	0.0198	38	0.431	44	0.0345	55	0.0174	NA	61
9 Hexachloro-benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
31 2,4-Dichloro-phenol	0.007	0.000003	ND	ND	ND	ND	0.044	0.000034	ND	ND	ND	ND
34 2,4-Dimethyl-phenol	ND	ND	0.0	0.0	0.163	0.00225	ND	ND	ND	ND	ND	0.0
39 Fluoranthene	0.176	0.000065	0.0	0.0	0.0	0.0	0.023	0.000018	0.0	0.0	0.0	0.0
65 Phenol	1.845	0.000677	0.0	0.0	0.630	0.00865	0.563	0.000441	0.011	0.000003	0.0	ND
73 Benzo(a)pyrene	0.008	0.000003	ND	ND	0.0	0.0	ND	ND	0.0	0.0	ND	0.0
76 Chrysene	0.054	0.000020	0.0	0.0	0.0	0.0	ND	ND	0.0	0.0	0.0	0.0
84 Pyrene	0.037	0.000014	ND	ND	0.0	0.0	0.012	0.000009	0.0	0.0	0.0	0.0
114 Antimony	NA	NA	NA	NA	0.015	0.000200	NA	NA	0.002	0.000001	0.0	0.025
115 Arsenic	NA	NA	NA	NA	0.006	0.000082	NA	NA	0.005	0.000002	0.004	0.029
118 Cadmium	0.006	0.000002	0.0	0.0	0.0	0.0	0.007	0.000005	0.017	0.000005	0.0	0.008
119 Chromium	0.052	0.000019	0.023	0.000007	0.0	0.0	0.006	0.000005	0.080	0.000025	0.025	0.082
120 Copper	0.186	0.000068	0.017	0.000005	0.026	0.000347	0.030	0.000024	0.123	0.000039	0.007	0.032
121 Cyanide (Total)	28.4	0.0104	0.045	0.000014	1.11	0.0153	0.227	0.000178	21.0	0.00666	NA	1.700
122 Lead	2.11	0.000774	0.090	0.000027	0.079	0.00109	0.083	0.000065	1.41	0.000447	0.0	0.238
124 Nickel	0.097	0.000036	0.0	0.0	0.0	0.0	0.060	0.000047	0.843	0.000267	0.111	0.280
125 Selenium	NA	NA	NA	NA	0.004	0.000054	NA	NA	0.001	0.000000	0.0	0.001
128 Zinc	27.5	0.0101	1.33	0.000406	0.935	0.0129	0.333	0.000261	33.1	0.0105	0.074	0.380

---

(1) A portion of this plant's ironmaking wastewater treatment system effluent is the filtrate from a vacuum filter.

ND : Not detected
NA : No analysis performed
ISD: Insufficient data to complete evaluation.
N/A: Not available

NOTES: FLFC - Flocculation with ferric chloride.
For a definition of C&TT codes, see Table VII-1.

TABLE VII-5

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
ORIGINAL GUIDELINES SURVEY
FERROMANGANESE BLAST FURNACE

Raw Wastewaters	Scrubber		Gas Cooler	
Plant Codes	0112C		0112C	
	Q		Q	
Sample Point(s)	2		5	
Flow, gal/ton(1)	2,233		5,705	
	mg/l	lbs/1000 lbs	mg/l	lbs/1000 lbs
pH, Units	12.2-12.2		8.6-8.7	
Ammonia (as N)	156	1.45	136	3.24
Manganese	2,960	27.6	6.05	0.144
Phenols (4AAP)	19.1	0.178	0.471	0.0112
Suspended Solids	17,260	161	57	1.36
121 Cyanide (T)	3,886	36.2	104	2.47
Effluent				
Sample Point(s)	-		No treatment provided	
Flow, gal/ton	0			
C&TT	T, VF, RTP-100			
	No discharge of wastewater pollutants			

TABLE VII-6

SUMMARY OF ANALYTICAL DATA FROM SAMPLED PLANTS
TOXIC POLLUTANT SURVEY
FERROMANGANESE BLAST FURNACE

	Raw Wastewaters		Effluent
Reference Code	0112C		0112C
Plant Code	025		025
Sample Point (s)	B+D		-
Flow, gal/ton	11,540		0
C&TT	-		CL, T, CT, RTP
	mg/l	lbs/1000 lbs	
Ammonia (as N)	711	34.2	
Manganese	253	12.2	
Phenols (4AAP)	6.5	0.312	
Suspended Solids	4,160	200	
pH	8.8-11.3		
4 Benzene	0.017	0.000818	
23 Chloroform	0.158	0.00760	
55 Naphthalene	0.038	0.00183	
85 Tetrachloroethylene	0.064	0.00308	
86 Toluene	0.013	0.000626	
115 Arsenic	7.67	0.369	
117 Beryllium	0.011	0.000529	
119 Chromium	0.176	0.00847	
121 Cyanide (Total)	692	33.3	
122 Lead	1.89	0.0910	
127 Thallium	0.328	0.0158	
128 Zinc	30.5	1.47	

TABLE VII-7

SUMMARY OF D-DCP ANALYTICAL DATA
IRON MAKING BLAST FURNACES

(All concentrations expressed in mg/l)

Plant Code	0112				0384A - Plant 2				0384A - Plant 3			
C&TT	FLP, NA, T, CT, VF, RTP96				SL, T, NA, CT, RTP				SL, T, NA, FLP, CT, RTP			
	No. of Samples	Mean	High	Standard Deviation	No. of Samples	Mean	High	Standard Deviation	No. of Samples	Mean	High	Standard Deviation
Flow, gal/min	531	370	573	114								
Temperature, °F												
pH, Units	501	6.85	8.2	-	390	8.0	8.4	-	390	7.7	8.4	-
Ammonia (N)	49	80.4	201.2	43.3	296	37	438	27	389	51	190	32
Fluoride												
Phenols (4AAP)	49	3.04	9.17	2.51	389	0.005	0.072	0.008	388	0.049	2.8	0.298
Suspended Solids	89	36.5	251.2	49.6	389	80	1331	79	387	27	157	16
Dissolved Solids												
9 Hexachlorobenzene					1	<0.01	-	-				
31 2,4-Dichlorophenol					1	<0.01	-	-				
34 2,4-Dimethylphenol					1	<0.01	-	-				
39 Fluoranthene					1	<0.01	-	-				
65 Phenol					1	<0.01	-	-				
73 Benzo(a)pyrene					1	<0.01	-	-				
76 Chrysene					1	<0.01	-	-				
84 Pyrene					1	<0.01	-	-				
114 Antimony					9	<0.01	-	-				
115 Arsenic					9	<0.01	-	-				
118 Cadmium					9	<0.01	-	-				
119 Chromium					9	<0.01	<0.1	-				
120 Copper					1	<0.01	-	-				
121 Cyanide (T)	532	3.93	35	6.08	221	0.86	4.7	1.09	381	0.23	5.6	1.52
122 Lead					9	<0.01	0.8	-				
124 Nickel					9	<0.01	<0.2	-				
125 Selenium					1	<0.01	-	-				
128 Zinc					1	<0.01	-	-				

TABLE VII-7
SUMMARY OF D-DCP ANALYTICAL DATA
IRON MAKING BLAST FURNACES
PAGE 2

(All concentrations expressed in mg/l)

Plant Code	0684F				0684H				0868A				0920B			
C&TT	PSP, Scr, FLP, FLFC, CL, SS, MA, CT, VF, RTP and RUP				A, NL, FLP, CLA, CL, VF, CT, RTP-92				FLP, T, SL, CT, RTP, and RUP				PSP, FLP, CL, NA, T, CT, RTP-96			
	No. of Samples	Mean	High	Standard Deviation	No. of Samples	Mean	High	Standard Deviation	No. of Samples	Mean	High	Standard Deviation	No. of Samples	Mean	High	Standard Deviation
Flow, gal/min	2077	1103	2979	527	609	486	560	46								
Temperature, °F	466	84.5	118	11.3									57	114	142	10
pH, Units	476	7.53	9.6	-	76	8.56	9.3	-	119	8.0	9.0	-	62	6.9	8.2	-
Ammonia (N)	123	25.2	124	17.3	76	14.9	62	10.9					10	54	110	30
Fluoride	6	5.73	9.42	2.98	76	6.52	15	3.21								
Phenols (4AAP)	124	0.068	0.75	0.115									13	0.5	3.5	0.9
Suspended Solids	1817	35.7	492	37.4	76	20.5	74	17.6	119	14	49	9.4	52	120	550	85
Dissolved Solids	1819	1050	1910	204									53	3600	8200	1600
118 Cadmium	7	0.008	0.01	0.001												
119 Chromium	7	0.028	0.049	0.012												
120 Copper	7	0.032	0.058	0.016												
121 Cyanide (T)	123	0.635	4.79	0.854	76	0.957	13.39	209					13	31	74	18
122 Lead	7	0.065	0.103	0.027												
124 Nickel	7	0.062	0.078	0.015												
128 Zinc	7	0.161	0.36	0.111					54	1.28	6.25	1.27				

NOTE: For a definition of C&TT codes, refer to Table VII-1.

TABLE VII-8

PLANT 0860B PILOT PLANT TREATABILITY STUDY
TOXIC ORGANIC POLLUTANT
ANALYTICAL DATA(1)
IRONMAKING SUBCATEGORY

		BPT Recycle System Blowdown (Pilot Plant Influent)			Chlorinator Effluent	Carbon Column Effluent
		1/23-26/80	2/20-22/80	3/18/80	11/28/79	11/28/79
4	Benzene	ND	ND	ND	0.002	0.002
23	Chloroform	ND	ND	ND	0.003	0.003
44	Methylene Chloride	ND	ND	ND	0.030	0.030
47	Bromoform	ND	ND	ND	0.035	<0.001
48	Dichlorobromomethane	ND	ND	ND	<0.001	0.003
51	Chlorodibromomethane	ND	ND	ND	0.027	<0.001
66	Bis(2-ethylhexyl)phthalate	0.096	0.030	ND	ND	ND
68	Di-n-butyl phthalate	0.002	ND	ND	ND	ND
70	Diethyl phthalate	0.001	ND	ND	ND	ND
86	Toluene	ND	ND	ND	<0.001	<0.001

---

(1) All values are expressed in mg/l. All toxic organic pollutants not included in the above list were not detected during the GC/MS analyses.

ND: Not detected

TABLE VII-9

PLANT 0860B PILOT PLANT TREATABILITY STUDY ANALYTICAL DATA(1) IRONMAKING SUBCATEGORY

Pollutant	No. of Measurements	Minimum Value	Maximum Value	Average Value	Daily Maximum Performance Standard	30-Day Average Performance Standard
Pilot Unit Influent (BPT Recycle System Blowdown)						
pH, Units	30	7.0	8.1	NA	NA	NA
Ammonia (N)	31	30.8	76.0	50.6	NA	NA
Fluoride	31	7.9	28.0	16.7	NA	NA
Phenols (4AAP)	31	0.001	0.593	0.09	NA	NA
TSS	31	2	47	15	NA	NA
121 Cyanide (T)	31	0.15	8.0	2.8	NA	NA
Pilot Unit Effluent (After alkaline chlorination and activated carbon						
pH, Units	40	7.3	9.1	NA	NA	NA
Ammonia (N)	42	0.10	3.40	0.66	5.18	0.92
Fluoride	42	8.2	20.0	12.2	16.0	13.1
Phenols, (4AAP)	41	0.000	0.04	0.003	0.016	0.005
TSS	41	1	19	3.5	16.5	4.5
121 Cyanide (T)	42	0.01	0.10	0.03	0.15	0.04

NA: Not applicable

(1) All concentrations are expressed in mg/l otherwise noted.

TABLE VII-10

PLANT 0860B BLAST FURNACE RECYCLE SYSTEM BLOWDOWN(1) ANALYTICAL DATA(2) IRONMAKING SUBCATEGORY

Pollutant	No. of Measurements	Minimum Value	Maximum Value	Average Value	Daily Maximum Performance Standard	30-Day Average Performance Standard
Ammonia (N)	102	4.7	98.1	53.1	117.0	57.7
Fluoride	5	16.4	22.4	19.3	26.1	20.1
Phenols (4AAP)	102	0.001	0.559	0.037	0.327	0.059
TSS	102	1	26	8.9	30.1	10.2
121 Cyanide (T)	102	0.01	7.86	1.85	14.53	2.32
128 Zinc	18	0.10	0.65	0.36	1.43	0.42

---

(1) This recycle system is equivalent to the BPT model system.
(2) All concentrations are expressed in mg/l unless otherwise noted.

Note: The above data were collected in conjunction with the pilot studies conducted at this plant.

TABLE VII-11

PLANT 0860B CHLORINATION ACTIVATED CARBON TREATMENT FACILITY EFFLUENT ANALYTICAL DATA(1) IRONMAKING SUBCATEGORY

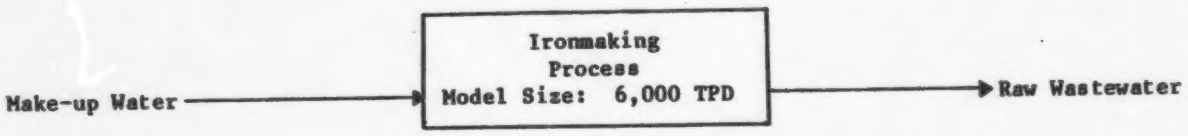
	Pollutant	No. of Measurements	Minimum Value	Maximum Value	Average Value	Daily Maximum Performance Standard(1)	30-Day Average Performance Standard(1)
	pH, Units	44	7.4	9.0	7.4 = 9.0	=	-
	Ammonia (N)(2)	37	¢0.100	16.5	4.51	31.7	5.70
	Phenols (4AAP)	41	¢0.001	0.077	0.015	0.179	0.022
	TSS(2)	36	0.5	78.0	3.6	25.7	4.8
121	Cyanide (T)	40	¢0.01	1.30	0.09	0.85	0.16
128	Zinc	7	¢0.05	0.75	0.18	1.02	0.25

---

(1) All concentrations are expressed in mg/l unless otherwise noted.
(2) Outliers removed

TABLE VII-12

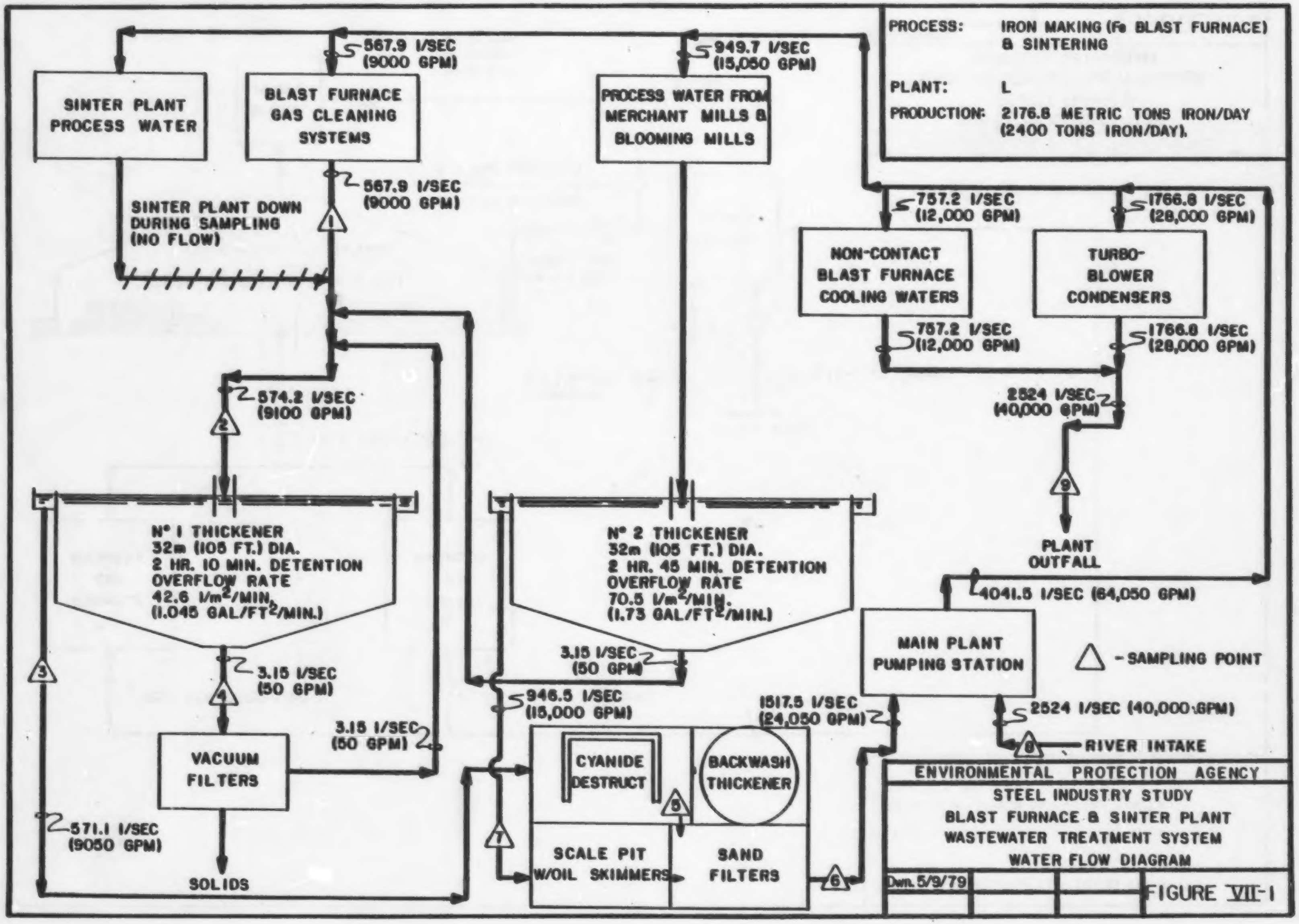
NET CONCENTRATION AND LOAD ANALYSIS


Make-up Water
Ironmaking
Process
Model Size: 6,000 TPD
Raw Wastewater

125 GPT x 6,000 TPD = 750,000 GPD

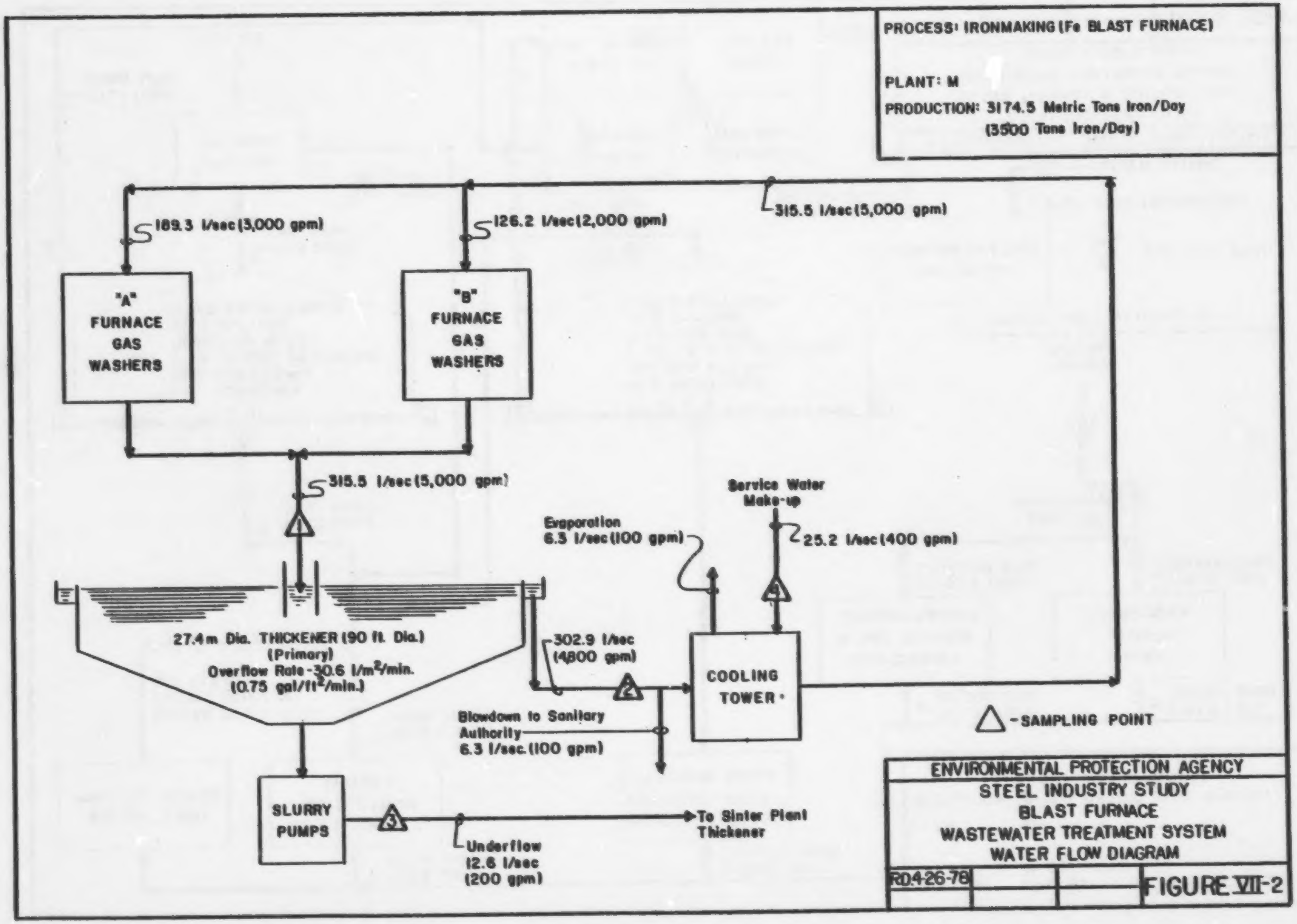
3,200 GPT x 6,000 TPD = 19.2 MGD

	Make-up				Raw Waste		Make-up as a % of
	Conc. (mg/1)			Avg. Load (lbs/day)	Avg. Conc. (mg/1)	Avg. Load (lbs/day)	Raw Waste Load
Regulated Pollutants	Min.	Max.	Avg.				
Ammonia (N)	0	2.0	0.44	2.75	20	3,203	0.086
Phenols (4AAP)	0	0.149	0.029	0.18	3	480.4	0.037
Total Suspended Solids	<1	55	14	87.57	1,900	304,243	0.029
121 Cyanide	<0.02	0.144	0.040	0.25	12	1,922	0.013
122 Lead	<0.020	0.066	0.012	0.075	5	800.6	0.009
128 Zinc	<0.020	0.200	0.068	0.43	20	3,203	0.013


PROCESS: IRON MAKING (Fe BLAST FURNACE) & SINTERING
PLANT: L
PRODUCTION: 2176.8 METRIC TONS IRON/DAY (2400 TONS IRON/DAY).
567.9 l/SEC (9000 GPM)
949.7 l/SEC (15,050 GPM)
SINTER PLANT PROCESS WATER
BLAST FURNACE GAS CLEANING SYSTEMS
PROCESS WATER FROM MERCHANT MILLS & BLOOMING MILLS
567.9 l/SEC (9000 GPM)
SINTER PLANT DOWN DURING SAMPLING (NO FLOW)
1
757.2 l/SEC (12,000 GPM)
1766.8 l/SEC (28,000 GPM)
NON-CONTACT BLAST FURNACE COOLING WATERS
TURBO-BLOWER CONDENSERS
757.2 l/SEC (12,000 GPM)
1766.8 l/SEC (28,000 GPM)
574.2 l/SEC (9100 GPM)
2
2524 l/SEC (40,000 GPM)
9
N° 1 THICKENER 32m (105 FT.) DIA. 2 HR. 10 MIN. DETENTION OVERFLOW RATE 42.6 l/m²/MIN. (1.045 GAL/FT²/MIN.)
N° 2 THICKENER 32m (105 FT.) DIA. 2 HR. 45 MIN. DETENTION OVERFLOW RATE 70.5 l/m²/MIN. (1.73 GAL/FT²/MIN.)
PLANT OUTFALL
4041.5 l/SEC (64,050 GPM)
3
3.15 l/SEC (50 GPM)
4
3.15 l/SEC (50 GPM)
946.5 l/SEC (15,000 GPM)
MAIN PLANT PUMPING STATION
- SAMPLING POINT
1517.5 l/SEC (24,050 GPM)
2524 l/SEC (40,000 GPM)
8
RIVER INTAKE
VACUUM FILTERS
3.15 l/SEC (50 GPM)
CYANIDE DESTRUCT
BACKWASH THICKENER
5
571.1 l/SEC (9050 GPM)
7
SCALE PIT W/OIL SKIMMERS
SAND FILTERS
6
SOLIDS
Dwn. 5/9/79

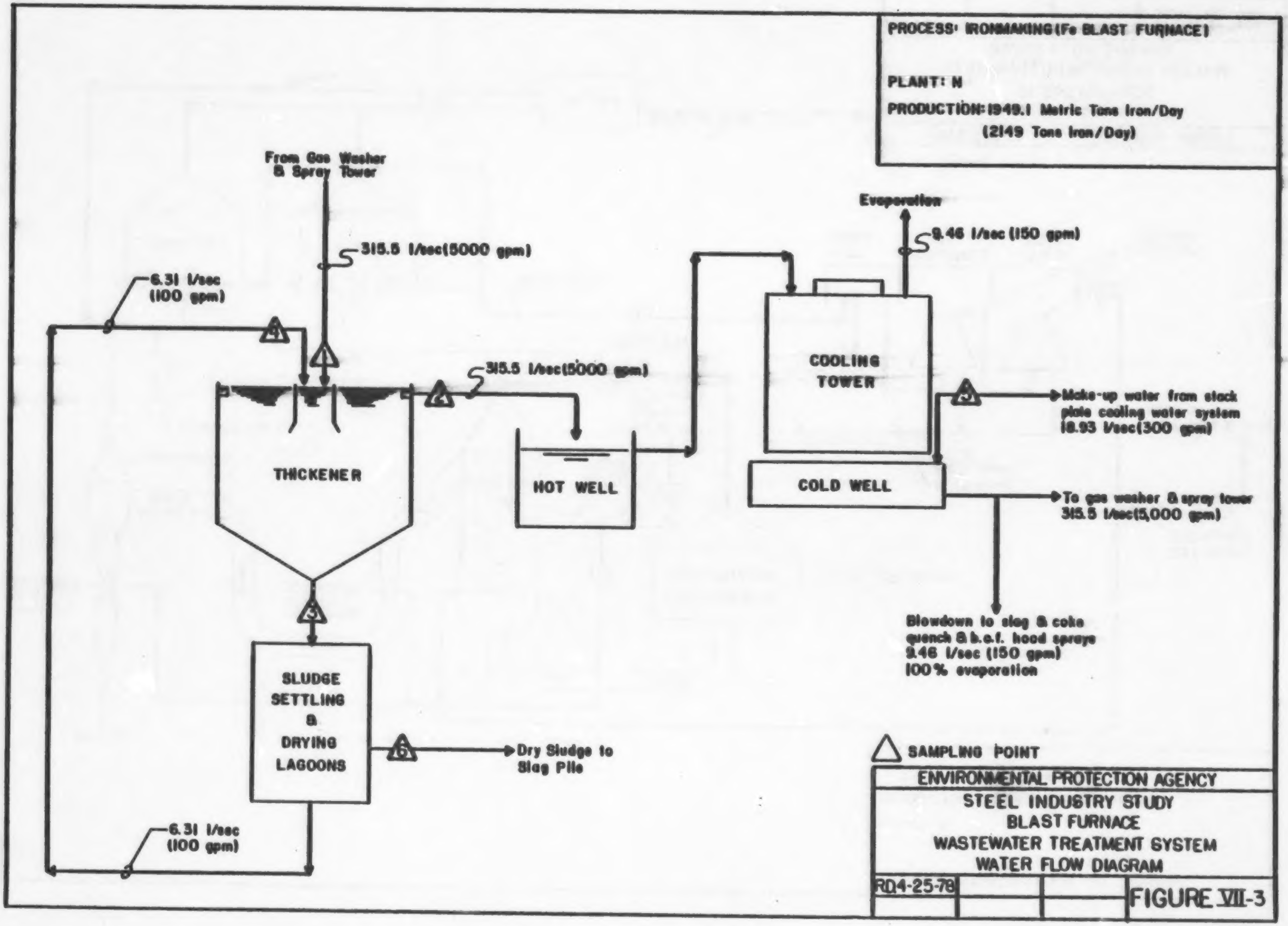
ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE & SINTER PLANT
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

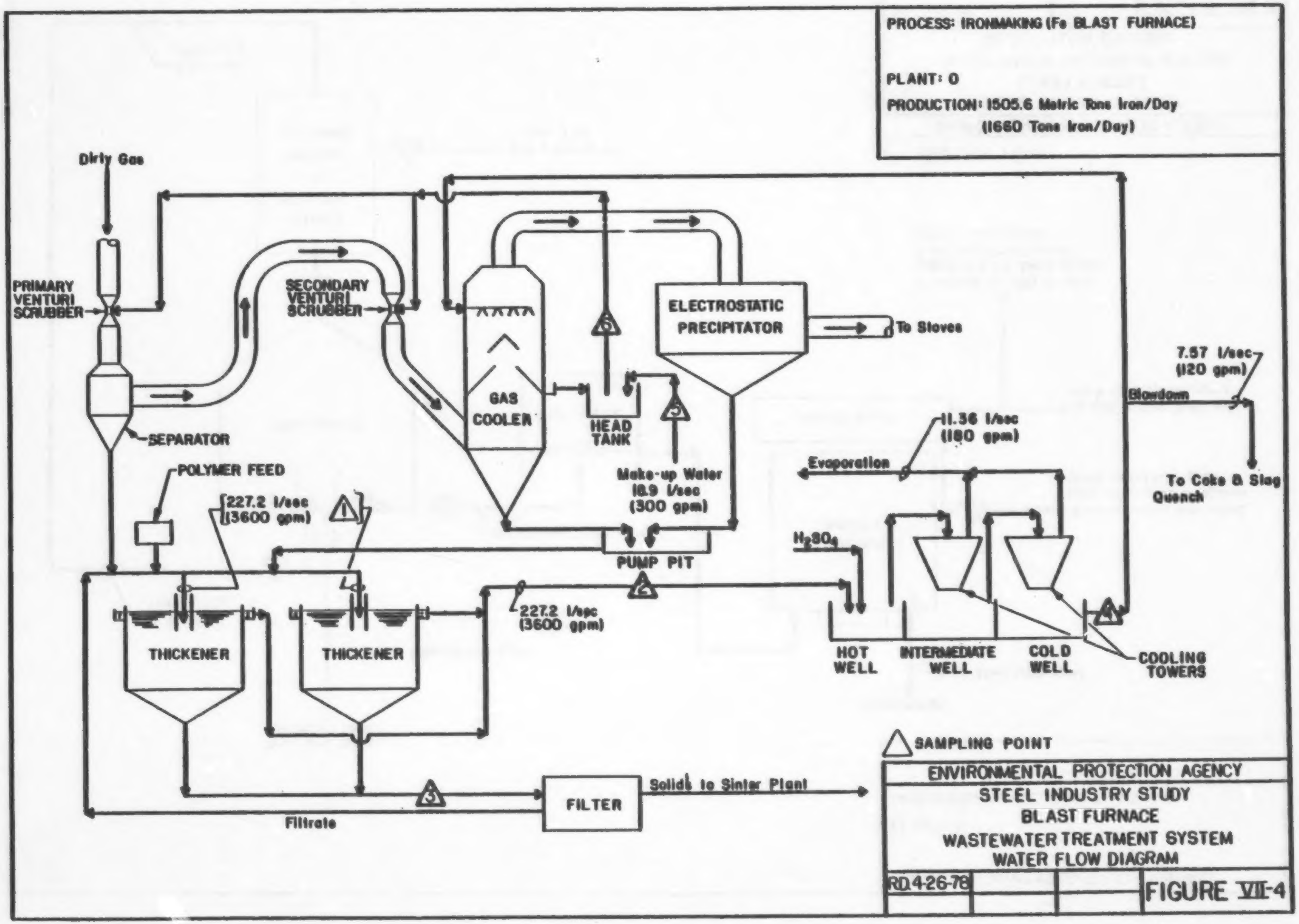
FIGURE VII-1


PROCESS: IRONMAKING (Fe BLAST FURNACE)
PLANT: M
PRODUCTION: 3174.5 Metric Tons Iron/Day
(3500 Tons Iron/Day)
189.3 l/sec (3,000 gpm)
126.2 l/sec (2,000 gpm)
315.5 l/sec (5,000 gpm)
"A" FURNACE GAS WASHERS
"B" FURNACE GAS WASHERS
315.5 l/sec (5,000 gpm)
1
Service Water Make-up
Evaporation
6.3 l/sec (100 gpm)
25.2 l/sec (400 gpm)
4
27.4m Dia. THICKENER (90 ft. Dia.)
(Primary)
Overflow Rate-30.6 l/m²/min.
(0.75 gal/ft²/min.)
302.9 l/sec
(4800 gpm)
2
COOLING TOWER
Blowdown to Sanitary Authority
6.3 l/sec. (100 gpm)
SLURRY PUMPS
3
Underflow
12.6 l/sec
(200 gpm)
To Sinter Plant Thickener
△ - SAMPLING POINT
R0 4-26-78

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-2


PROCESS: IRONMAKING (Fe BLAST FURNACE)
PLANT: N
PRODUCTION: 1949.1 Metric Tons Iron/Day
(2149 Tons Iron/Day)
From Gas Washer & Spray Tower
315.5 l/sec (5000 gpm)
6.31 l/sec (100 gpm)
4
1
THICKENER
2
315.5 l/sec (5000 gpm)
HOT WELL
3
SLUDGE SETTLING & DRYING LAGOONS
6
Dry Sludge to Slag Pile
6.31 l/sec (100 gpm)
Evaporation
9.46 l/sec (150 gpm)
COOLING TOWER
5
Make-up water from stack plate cooling water system 18.93 l/sec (300 gpm)
COLD WELL
To gas washer & spray tower 315.5 l/sec (5,000 gpm)
Blowdown to slag & coke quench & b.o.f. hood sprays 9.46 l/sec (150 gpm) 100% evaporation
SAMPLING POINT
ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM
RD4-25-78
FIGURE VII-3


Dirty Gas
PRIMARY VENTURI SCRUBBER
SEPARATOR
SECONDARY VENTURI SCRUBBER
GAS COOLER
HEAD TANK
ELECTROSTATIC PRECIPITATOR
To Stoves
Make-up Water 18.9 l/sec (300 gpm)
PUMP PIT
POLYMER FEED
227.2 l/sec (3600 gpm)
227.2 l/sec (3600 gpm)
THICKENER
THICKENER
FILTER
Filtrate
Solids to Sinter Plant
H_2SO_4
Evaporation
11.36 l/sec (180 gpm)
HOT WELL
INTERMEDIATE WELL
COLD WELL
COOLING TOWERS
Blowdown
7.57 l/sec (120 gpm)
To Coke & Slag Quench
1
2
3
4
5
6
SAMPLING POINT

PROCESS: IRONMAKING (Fe BLAST FURNACE)

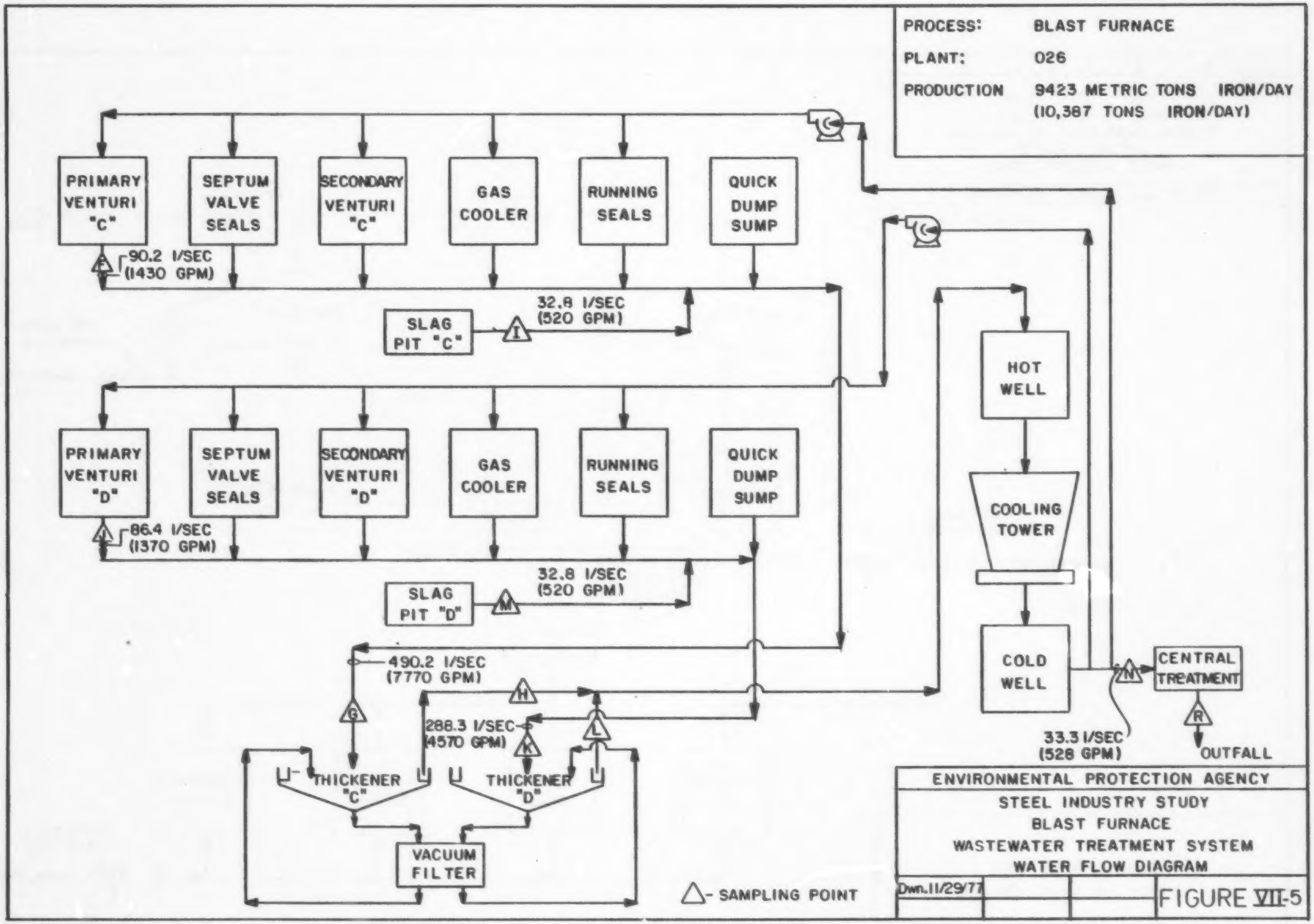
PLANT: O

PRODUCTION: 1505.6 Metric Tons Iron/Day
(1660 Tons Iron/Day)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

RD 4-26-78

FIGURE VII-4

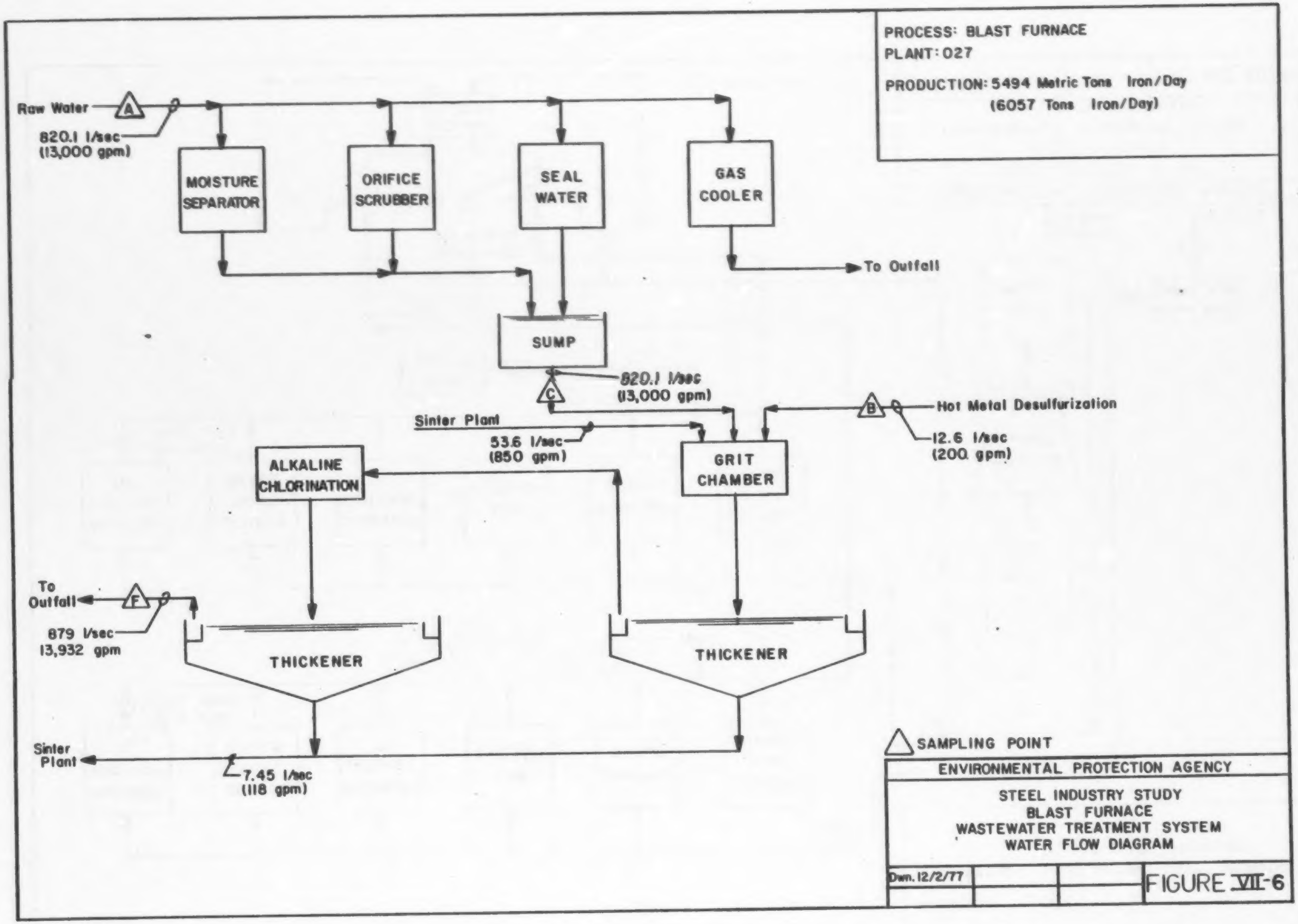

PRIMARY VENTURI "C"
SEPTUM VALVE SEALS
SECONDARY VENTURI "C"
GAS COOLER
RUNNING SEALS
QUICK DUMP SUMP
F
90.2 l/SEC (1430 GPM)
SLAG PIT "C"
I
32.8 l/SEC (520 GPM)
PRIMARY VENTURI "D"
SEPTUM VALVE SEALS
SECONDARY VENTURI "D"
GAS COOLER
RUNNING SEALS
QUICK DUMP SUMP
J
86.4 l/SEC (1370 GPM)
SLAG PIT "D"
M
32.8 l/SEC (520 GPM)
490.2 l/SEC (7770 GPM)
G
H
288.3 l/SEC (4570 GPM)
K
L
THICKENER "C"
THICKENER "D"
VACUUM FILTER
HOT WELL
COOLING TOWER
COLD WELL
N
33.3 l/SEC (528 GPM)
CENTRAL TREATMENT
R
OUTFALL
△- SAMPLING POINT

PROCESS: BLAST FURNACE
PLANT: 026
PRODUCTION 9423 METRIC TONS IRON/DAY
(10,387 TONS IRON/DAY)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

Dwn.11/29/77

FIGURE VII-5

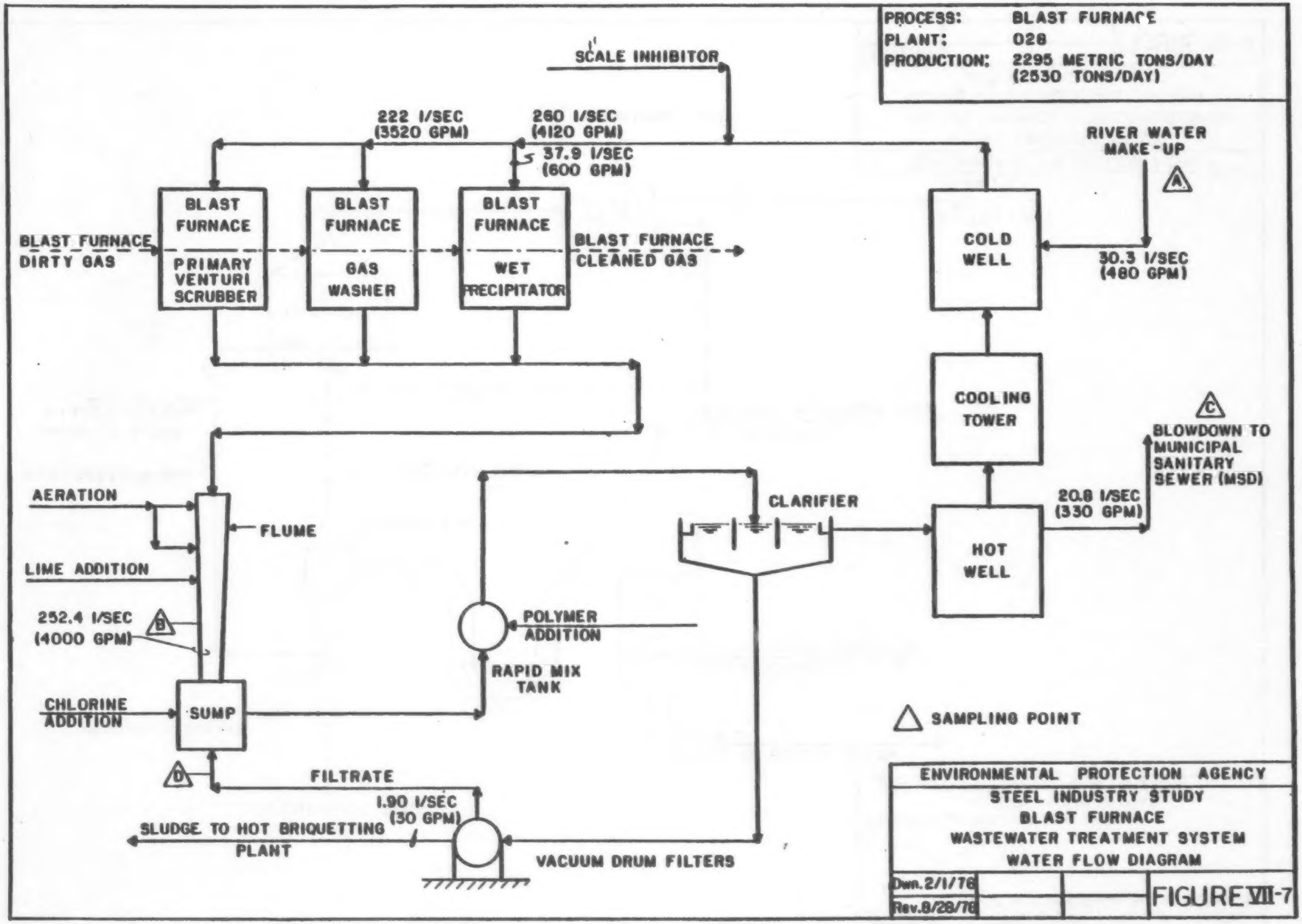

Raw Water
A
820.1 l/sec
(13,000 gpm)
MOISTURE SEPARATOR
ORIFICE SCRUBBER
SEAL WATER
GAS COOLER
To Outfall
SUMP
C
820.1 l/sec
(13,000 gpm)
Sinter Plant
53.6 l/sec
(850 gpm)
B
Hot Metal Desulfurization
12.6 l/sec
(200 gpm)
GRIT CHAMBER
ALKALINE CHLORINATION
To Outfall
F
879 l/sec
13,932 gpm
THICKENER
THICKENER
Sinter Plant
7.45 l/sec
(118 gpm)
SAMPLING POINT
Dwn. 12/2/77

PROCESS: BLAST FURNACE
PLANT: 027
PRODUCTION: 5494 Metric Tons Iron/Day
(6057 Tons Iron/Day)

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BLAST FURNACE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-6

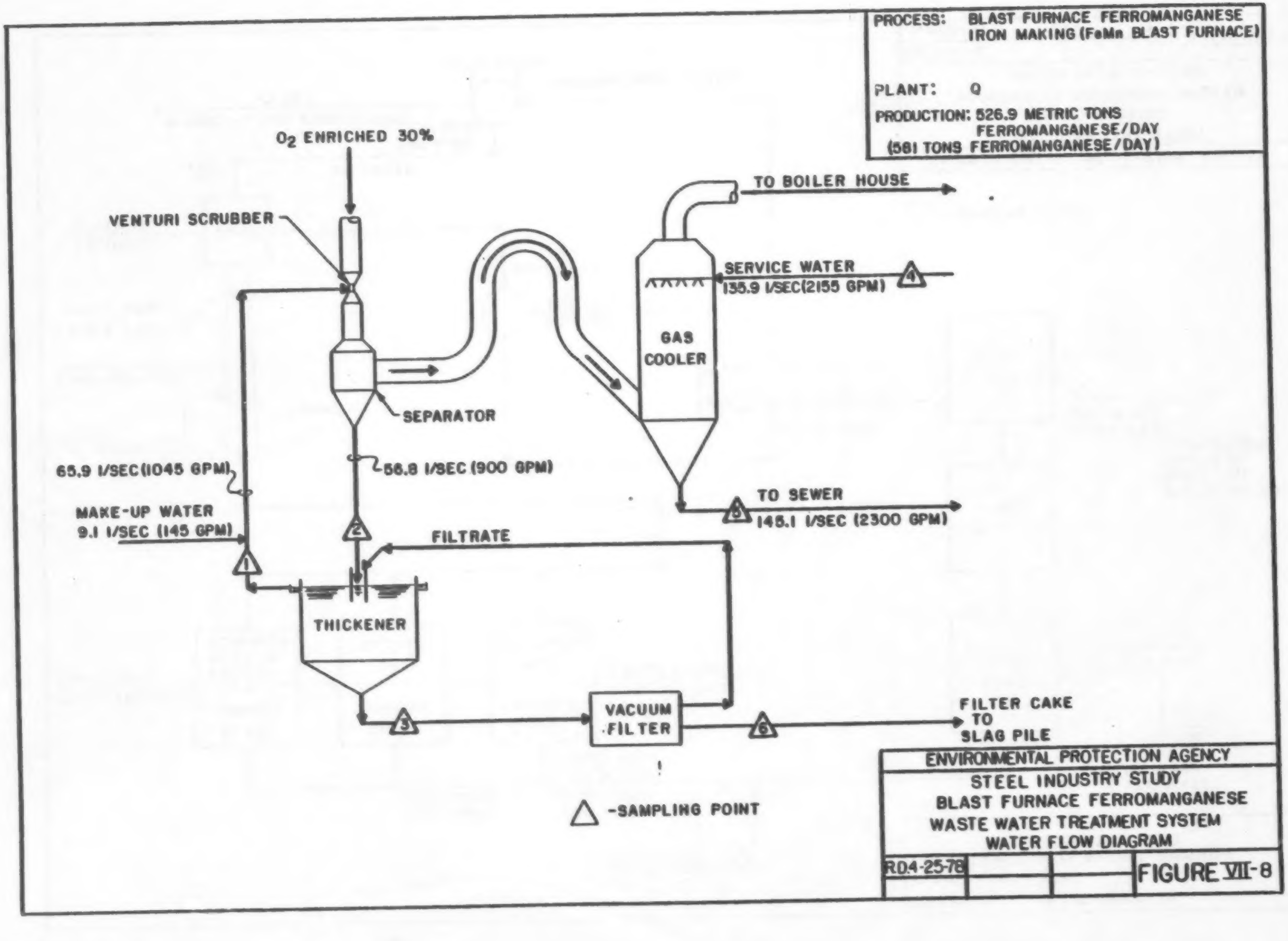

PROCESS: BLAST FURNACE
PLANT: 028
PRODUCTION: 2295 METRIC TONS/DAY (2530 TONS/DAY)
SCALE INHIBITOR
222 l/SEC (3520 GPM)
260 l/SEC (4120 GPM)
37.9 l/SEC (600 GPM)
RIVER WATER MAKE-UP
A
BLAST FURNACE DIRTY GAS
BLAST FURNACE
PRIMARY VENTURI SCRUBBER
BLAST FURNACE
GAS WASHER
BLAST FURNACE
WET PRECIPITATOR
BLAST FURNACE CLEANED GAS
COLD WELL
30.3 l/SEC (480 GPM)
COOLING TOWER
C
BLOWDOWN TO MUNICIPAL SANITARY SEWER (MSD)
AERATION
FLUME
LIME ADDITION
252.4 l/SEC (4000 GPM)
B
CLARIFIER
HOT WELL
20.8 l/SEC (330 GPM)
POLYMER ADDITION
RAPID MIX TANK
CHLORINE ADDITION
SUMP
D
FILTRATE
1.90 l/SEC (30 GPM)
SLUDGE TO HOT BRIQUETTING PLANT
VACUUM DRUM FILTERS
△ SAMPLING POINT

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BLAST FURNACE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

Dwn. 2/1/76
Rev. 8/28/76

FIGURE VII-7


O2 ENRICHED 30%
VENTURI SCRUBBER
SEPARATOR
GAS COOLER
TO BOILER HOUSE
SERVICE WATER
135.9 l/SEC(2155 GPM)
4
65.9 l/SEC(1045 GPM)
56.8 l/SEC (900 GPM)
MAKE-UP WATER
9.1 l/SEC (145 GPM)
1
2
FILTRATE
TO SEWER
5
145.1 l/SEC (2300 GPM)
THICKENER
3
VACUUM FILTER
6
FILTER CAKE TO SLAG PILE
△ -SAMPLING POINT
R0.4-25-78

PROCESS: BLAST FURNACE FERROMANGANESE IRON MAKING (FeMn BLAST FURNACE)

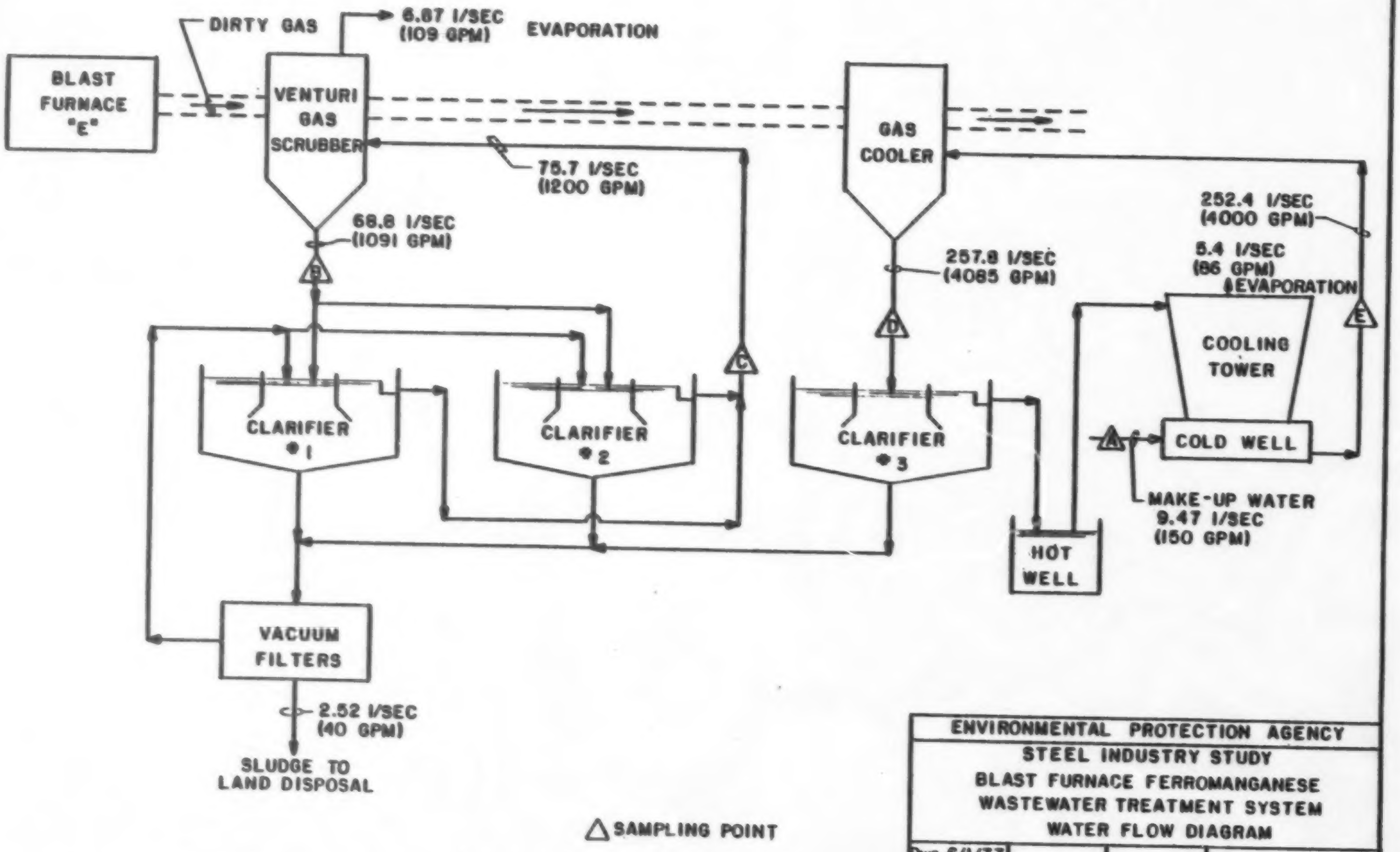
PLANT: Q

PRODUCTION: 526.9 METRIC TONS FERROMANGANESE/DAY
(581 TONS FERROMANGANESE/DAY)

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE FERROMANGANESE
WASTE WATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

FIGURE VII-8

PROCESS: BLAST FURNACE (FERROMANGANESE)
PLANT: 025
PRODUCTION: 586 METRIC TONS/DAY
(646 TONS/DAY)


BLAST FURNACE "E"
DIRTY GAS
VENTURI GAS SCRUBBER
6.87 l/SEC (109 GPM) EVAPORATION
75.7 l/SEC (1200 GPM)
68.8 l/SEC (1091 GPM)
B
C
GAS COOLER
257.8 l/SEC (4085 GPM)
D
252.4 l/SEC (4000 GPM)
5.4 l/SEC (86 GPM) EVAPORATION
E
COOLING TOWER
COLD WELL
A
MAKE-UP WATER 9.47 l/SEC (150 GPM)
CLARIFIER #1
CLARIFIER #2
CLARIFIER #3
HOT WELL
VACUUM FILTERS
2.52 l/SEC (40 GPM)
SLUDGE TO LAND DISPOSAL
△ SAMPLING POINT

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
BLAST FURNACE FERROMANGANESE
WASTEWATER TREATMENT SYSTEM
WATER FLOW DIAGRAM

Dwn. 6/1/77
Rev. 8/29/78

FIGURE VII-9

IRONMAKING SUBCATEGORY

SECTION VIII

COST, ENERGY AND NON-WATER QUALITY ASPECTS

Introduction

This section presents the incremental costs which the Agency estimates the industry will incur in meeting the limitations and standards. These costs were determined on the basis of the appropriate model wastewater treatment systems. The analysis includes a consideration of energy requirements; non-water quality impacts; and, the techniques, magnitude and costs associated with the application of the BPT, BAT, BCT, NSPS, PSES and PSNS model wastewater treatment technologies. This section also reviews the consumptive use of water as it relates to the ironmaking subcategory.

Comparison of Industry Costs and EPA Model Costs

Tables VIII-1 and VIII-2 present the water pollution control costs reported by dischargers which were sampled during the original or toxic pollutant surveys or which responded to the D-DCPs. The reported costs have been updated to July 1978 dollars. In most instances, standard cost of capital and depreciation factors were applied to the reported costs to determine those portions of the annual costs of operation. In the remaining instances, these costs were provided by the industry. The amortization costs reported by the industry (cost of capital and depreciation) are similar to the amortization costs which would have been determined by applying the factors noted on the tables.

As shown below, the capital cost data provided by the industry are compared with the Agency's estimates of required expenditures for eleven plants. The Agency's estimates are based upon the model treatment system factored to the size of each of the eleven plants.

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Plant No.	Actual Costs	Estimated Costs
0060	2,963,000	5,158,700
*0060F	6,020,000	5,226,300
*0112	7,384,000	13,425,400
*0112D	8,217,000	14,327,300
0320	14,806,000	10,808,100
0384A	20,896,000	22,284,500
*0396A	1,664,000	6,786,400
0432A	9,290,000	9,572,600
0684F	22,507,000	16,238,400
*0868A	4,707,000	7,637,800
*0920B	5,172,000	7,921,800
0946A	6,492,000	4,004,700
TOTAL	110,118,000	123,392,000

*Plants with effluent flows equal to or less than the BPT treatment model effluent flow of 125 gal/ton.

NOTE: The data reported for Plant 0684F include costs for screening, settling tanks, and other items not included in the Agency's estimated costs. There are two blast furnace wastewater treatment facilities at this plant.

Estimated costs for two-thirds of the plants listed above are greater than the actual costs reported for these plants. More important, however, is the comparison of the actual and estimated costs totals, as this comparison reflects upon the overall accuracy of the Agency's estimate of the costs of compliance for the entire ironmaking subcategory. Since actual costs are 89 percent of the estimated costs, the Agency concluded that its estimates fairly reflect the actual cost of compliance with the limitations and standards, and that these estimates are sufficient to account for site-specific and other incidental costs (such as retrofit). A more detailed discussion of this issue is presented in Section VII of Volume I. It should also be noted that the reported cost total for those plants with effluent flows equal to or less than the BPT treatment model effluent flow is only 60 percent of the estimated cost total for these plants. This demonstrates that the limitations and standards may be achieved at less cost than estimated by the Agency.

In addition, the Agency compared its estimated costs for its model treatment system with a cost estimate prepared by an engineering firm for the same model treatment system. This firm estimated the costs for the second BAT treatment alternative in the October 1979 draft development document and supplied its estimate as a comment regarding the draft development document. A comparison of the flow basis and estimated costs for the treatment model and company model follows:

	EPA Estimate	Engineering Firm Estimate
Flow	50 gal/ton	100 gal/ton
Capital	$2.49 million	$3.94 million

Reviewing the cost figures alone, the Agency's estimate would appear to be significantly less than the engineering firm's estimate. Upon further analysis, however, it is clear that the difference between the estimated costs is attributable to the different flow basis used to size the treatment components. The Agency's estimated cost is $3.78 million, when the Agency's flow basis is adjusted to conform to the engineering firm's model (100 gal/ton). This is within 4.1 percent of this engineering firm's unsolicited estimate thereby providing a further check on the Agency's costing methodology. The general discussion regarding this issue in Volume I provides further verification of the accuracy of the Agency's estimates of treatment model costs.

Control and Treatment Technology in Use or Available to Blast Furnace Operations

The technologies in use or available for use to treat blast furnace wastewaters are presented in Table VIII-3. It should be noted that a discharger is not required to use any of the model technology components, as any method of treatment which achieves the effluent limitations or standards is adequate. In addition to listing the treatment methods available, these tables provide the following for each component:

1. Description
2. Implementation time
3. Land requirements

Later in this section, the Agency sets out the estimated costs for the individual components of these treatment systems.

With the exception of the vapor compression distillation component, all of the treatment technologies listed on Table VIII-3 are demonstrated within the ironmaking subcategory. As noted in Section VII, these technologies have been proven to be reliable and effective for treatment of ironmaking wastewaters. Vapor compression distillation is a technology which has been demonstrated in other industries. Refer to Section VII for additional details regarding this technology.

Estimated Cost for the Installation of Pollution Control Technologies

A. Costs Required to Achieve the BPT Limitations

The first step in determining the estimated costs of compliance involved the development of a treatment model upon which the cost estimates could be based. The model size (tons/day) was developed on the basis of the average production capacity for all blast furnace sites. This method was used so that the concept of joint treatment of wastewaters from several blast furnaces at one site could be more accurately represented. The Agency developed the applied flow for the model treatment system on the same basis.

The components and effluent flows discussed in Sections IX and X were then included to complete the development of the treatment model. Subsequently, unit costs for each treatment model component were developed. Table VIII-4 presents the estimated investment and annual expenditures associated with the application of BPT model treatment technologies to the model plant. The capital and annual costs needed to achieve the BPT level of treatment were determined for each blast furnace site by adjusting the model treatment component costs for plant capacity using the 0.6 power factor. These estimates pertain to only iron blast furnaces as no ferromanganese blast furnaces are currently in operation. As noted previously, ferromanganese blast furnace production has been only a minor segment of all ironmaking operations. In order to assess the economic impact of the BPT effluent limitations upon the industry, the Agency estimated the expenditures required to bring each blast furnace site from current (July 1, 1981) treatment levels to the BPT level. The initial status of each plant was determined from DCP responses which described the treatment facilities in-place as of January 1978. The Agency has updated the status to July 1, 1981, taking into account the blast furnaces that have since been retrofitted with BPT treatment systems, and the permanent retirement of some older, uncontrolled furnaces. The estimated capital requirement of BPT for this subcategory is $22.4 million, while the estimated annual cost is $2.7 million. The capital and annual costs of treatment facilities in-place, as of July 1, 1981, at existing iron blast furnaces amount to $412.3 million and $52.5 million, respectively.

B. Costs Required to Achieve the BAT Limitations

The Agency considered six BAT alternative treatment systems for the ironmaking subcategory. Each of the systems is depicted in Figure VIII-1. The descriptions, rationale, and additional details for these alternatives are provided in Section X. The Agency's estimates of the investment and annual costs for the BAT treatment alternatives are presented in Table VIII-5. The treatment costs for each site were determined by adjusting the model treatment costs for size. Total estimated capital and annual costs for the subcategory represent the sum of the treatment costs for each active iron blast furnace site. The estimated investment and annual costs for each alternative treatment system for the ironmaking subcategory are as follows:

BAT Alternative	Investment Costs[1]($) In-place	Investment Costs[1]($) Required	Annual Costs ($) In-place	Annual Costs ($) Required
1	578,600	6,997,800	89,400	934,400
2	1,318,600	9,963,900	154,400	1,333,300
3	3,530,800	11,268,300	550,400	1,714,400
4	7,630,500	23,204,500	2,266,400	6,771,700
5	10,756,900	112,334,400	2,662,100	18,365,000
6	0	171,635,900	0	35,055,000

(1) Four plants which already discharge to quenching operations are not considered in alternatives two through six, as the Agency expects that wastewaters from these plants will continue to be disposed of in this manner.

As noted in Section X, the BAT effluent limitations are based upon BAT Alternative 4. The Agency recognizes, however, that wastewaters from some plants will be disposed of by evaporation on slag (Treatment Alternative 1). Although less expensive than BAT-4, BAT 1 can be used to achieve the BAT limitations at many plants. The Agency did not promulgate BAT limitations based upon BAT Alternative 1 because not all blast furnaces are equipped with adjacent slag processing operations. For the purpose of determining industry cost requirements, the Agency assumed that BAT-4 would be installed at all blast furnace sites, with the exception of the four plants currently achieving zero discharge through slag quenching. This is a conservative assumption since a survey conducted by the Agency indicates that 60% of the plants may be able to achieve compliance through BAT-1. The actual costs incurred by the industry may, therefore, be substantially less than estimated by the Agency. The Agency is also aware of certain technologies that may be innovative for treating ironmaking wastewaters to achieve the BAT limitations at less cost. These technologies may also see widespread use in the industry.

C. BCT Cost Comparison

The BCT analysis was not performed since the governing BCT regulation was remanded by the Fourth Circuit Court (See Volume I). BCT effluent limitations have been reserved for the ironmaking subcategory.

D. Costs Required to Achieve NSPS

Seven alternative treatment systems, depicted in Figure VIII-1, were developed for new blast furnaces. The NSPS alternative treatment systems include the treatment components of the model BPT and BAT alternative treatment sytems. The NSPS model treatment costs are presented in Table VIII-5.

E. Costs Required to Achieve the Pretreatment Standards

Pretreatment standards apply to those plants which discharge to POTW systems. The seven pretreatment alternatives are the same as the NSPS model treatment systems. These systems, shown in Figure VIII-1, provide for reductions in toxic pollutant discharge levels and in effluent flows. Refer to Section XIII for additional information pertaining to pretreatment standards. The model costs for the pretreatment alternatives are included in Table VIII-5. The capital annual costs for the two existing indirect dischargers were determined by adjusting the model treatment costs for size. The total costs for each PSES model treatment system are as follows:

PSES	Investment Costs ($)		Annual Costs ($)	
Alternative	In-place	Required	In-place	Required
1	12,916,700	0	2,133,900	0
2	0	232,800	0	32,700
3	0	386,400	0	51,700
4	60,400	386,300	10,200	53,800
5	297,500	648,700	120,900	176,400
6	297,500	3,849,400	120,900	591,000
7	0	5,966,200	0	1,218,500

The costs for alternatives 2 through 7 are incremental over the costs for alternative 1.

Energy Impacts Due to the Installation of the Alternative Technologies

Comparatively modest amounts of energy are required by the various levels of treatment for the ironmaking subcategory. The major energy expenditures are being incurred at the BPT level while the BAT alternative treatment systems require relatively minor additional energy expenditures. This relationship reflects the use of vacuum filters, cooling towers, and primary recycle technologies (the major energy consumers) in BPT. Energy requirements at the NSPS, PSES and PSNS levels of treatment will be similar to the total of the corresponding BPT and BAT treatment systems.

A. Energy Impacts at BPT

The Agency estimates that the BPT treatment components for all ironmaking operations consume about 420.0 million kilowatt hours of electricity per year. This figure represents 0.74% of the 57 billion kilowatt hours of electricity used by the steel industry in 1978.

B. Energy Impacts at BAT

The estimated subcategory BAT energy requirements, and the respective percent of industry power use in 1978, are as follows:

BAT Alternative	Million kwh/yr	% of Industry Usage
1	4.30	0.008
2	3.74	0.007
3	5.15	0.009
4	13.26	0.023
5	29.08	0.052
6	545.22	0.96

The Agency considers the energy requirements set out above to be reasonable and justified, especially when compared to the total industry energy use and the pollutant reduction benefits described below.

C. Energy Impacts at NSPS, PSES and PSNS.

The Agency estimates of the energy requirements for the NSPS and Pretreatment models are as follows:

PSES Alternative	Million kwh/yr	% of Industry Usage
1	19.54	0.034
2	0.20	0.00035
3	0.19	0.00033
4	0.18	0.00032
5	0.59	0.0010
6	1.44	0.0025
7	27.96	0.049

Model	Million kwh/yr
NSPS/PSNS -1	9.77
NSPS/PSNS -2	9.87
NSPS/PSNS -3	9.86
NSPS -4	9.90
PSNS -4	9.86
NSPS -5	10.11
PSNS -5	10.06
NSPS -6	10.53
PSNS -6	10.49
NSPS/PSNS -7	23.75

The energy requirements for PSES-2 through 7 are incremental over the requirements for PSES-1.

Non-water Quality Impacts

There are minimal non-water quality impacts associated with the model technologies. Three impacts were analyzed: air pollution, solid waste disposal, and water consumption. The analysis conducted for the ironmaking subcategory found that no significant non-water quality impacts will result from the installation of the treatment systems under consideration.

A. Air Pollution

The use of wet cooling towers in the BPT model treatment system may result in the atmospheric discharge of volatile compounds and ammonia-N. Cooling tower drift may contain toxic pollutants at levels similar to those present in recycled wastewaters. However, the Agency believes that any adverse environmental impact associated with these emissions is minimal and localized. As no other air pollution impacts are expected as a result of industry's compliance with the BPT limitations, the Agency concluded that there are no significant air pollution impacts associated with the limitations.

With respect to the BAT alternative treatment systems, the evaporation of process wastewaters on slag (BAT Alternative 1) may result in the emission of pollutants contained in the wastewater into the atmosphere, however, this impact will also be minimal and localized. Activated carbon regeneration (required in association with BAT 5), may also result in the emission of some pollutants found in the wastewater. However, under proper operating conditions these pollutants would be incinerated.

B. Solid Waste Disposal

The model BPT and BAT alternative treatment systems will generate quantities of solid wastes. A summary of the solid waste generation rates (on a dry solids basis) at the BPT and BAT levels of treatment for the ironmaking subcategory is as follows:

Treatment Level	Solid Waste Generation for the Subcategory (Tons/Year)
BPT	5.14 million
BAT-1	Minimal
BAT-2	Minimal
BAT-3	7,800
BAT-4	21,450
BAT-5	21,450
BAT-6	Minimal

Although the quantities of solids generated at the BPT level are substantial, these solids are often sintered and thus reused in the blast furnace. Moreover, the incremental solid wastes generated at the BAT level are not significant compared to those generated at BPT.

The Agency estimates that the NSPS and Pretreatment alternative treatment systems will generate the following amounts of solid wastes on a model plant basis:

Treatment Level	Solid Waste Generation for the Treatment Model (Tons/Year)
NSPS/PSES/PSNS - 1	119,465
NSPS/PSES/PSNS - 2	119,465
NSPS/PSES/PSNS - 3	119,465
NSPS/PSES/PSNS - 4	119,665
NSPS/PSES/PSNS - 5	120,015
NSPS/PSES/PSNS - 6	120,015
NSPS/PSES/PSNS - 7	119,465

As noted previously, the NSPS, PSES, and PSNS alternative treatment systems are similar to the BPT and BAT treatment systems. The solid wastes generated at the NSPS, PSES and PSNS levels of treatment are of the same nature as the solid wastes generated by the model BPT and BAT alternative treatment systems and thus present the same disposal requirements and possibilities for reprocessing.

C. Water Consumption

In the ironmaking subcategory, the Agency has included wet cooling towers in the BPT, BAT, NSPS, PSES and PSNS alternative treatment systems. Wet cooling towers are presently used at nearly 90% of the blast furnace sites to reduce system heat loads and thus permit higher recycle rates. The use of those devices results in some degree of water consumption (in the form of evaporation and drift). In response to the Third Circuit Court's remand of this issue, the Agency carefully analyzed the amount of water consumed by evaporation and drift. In addition, the Agency analyzed the amount of water which will be evaporated for those discharges employing BAT Alternative 1 (evaporation of process wastewater on slag).

The total water usage in the subcategory is 864 MGD. The Agency estimates that the net amount (i.e., in addition to current consumption) of water which would be consumed in the ironmaking subcategory at the BPT and BAT levels of treatment are as follows:

Treatment Level	Net Water Consumption	% of Total Volume Applied
BPT	3.0 MGD	0.36
BAT-1	18.1 MGD	2.1
BAT-2	0.1 MGD	0.01
BAT-3	0.1 MGD	0.01
BAT-4	0.1 MGD	0.01
BAT-5	0.1 MGD	0.01
BAT-6	0.1 MGD	0.01

The estimates set out above are in addition to the 11.2 MGD of water presently consumed in existing cooling devices (1.3% of total applied volume).

Based upon the relevant factors discussed in Section III of Volume I, as well as those discussed above, the Agency has concluded that the impact of the limitations and standards for the ironmaking subcategory on the consumption of water in the steel industry on both a nationwide and an arid and semi-arid regional basis is minimal and justified, especially in light of the effluent reduction benefits associated with these limitations and standards. Recycle systems have been installed at three of the four blast furnace operations in arid or semi-arid regions, and a recycle system is currently being installed at the remaining operation. Thus, these effluent limitations will cause no significant incremental water consumption at plants located in "arid" and "semi-arid" regions.

Summary of Impacts

The Agency concludes that the effluent reduction benefits shown below justify the adverse environmental impacts associated with energy consumption, air pollution, solid waste, and water consumption discussed above:

Raw Waste and Effluent Loads (Tons/Year)

	Direct Discharges			Indirect Discharges	
	Raw Waste	BPT	BAT-4	Raw Waste	PSES
Flow (MGD)	825.6	29.2	16.4	38.4	0.8
Ammonia (N)	25,147.2	2,672.8	149.7	1,169.6	7.7
Cyanide, Total	15,088.3	178.2	0.7	701.8	0.0
Fluoride	18,860.4	2,004.6	498.9	877.2	25.6
Phenols (4AAP)	3,772.1	102.5	0.4	175.4	0.0
TSS	2,388,979.8	1,871.0	548.8	111,115.3	28.1
Toxic Metals	33,382.7	77.1	11.4	1,552.7	0.6
Toxic Organics(1)	201.2	7.1	4.0	9.4	0.2

(1)Does not include cyanide or any of the individual phenolic compounds.

The Agency also concludes that the effluent reduction benefits associated with compliance with new source standards (NSPS, PSNS) outweigh the adverse energy and non-water quality environmental impacts.

TABLE VIII-1

EFFLUENT TREATMENT COSTS
IRONMAKING BLAST FURNACES
(ALL COSTS ARE EXPRESSED IN JULY, 1978 DOLLARS)

Plant Code Reference No.	L 0946A	M 0396A	N 0448A	O 0060F	026 0112D	027 0432A	0684H
Initial Investment Cost	$6,491,520	$1,664,000	$428,370(2)	$6,019,896	$8,216,700	$9,290,280(3)	$5,246,770
Annual Costs							
Capital(1)	$583,588	$149,594	-	$541,189	-	$835,196	-
Cost of Capital	-	-	-	-	$532,500(4)	-	$209,871(4)
Depreciation	-	-	-	-	547,780(4)	-	$349,785(4)
Operation and Maintenance	198,425	NR	-	171,059	1,169,000	407,123	351,410
Energy, Power, Chemicals, etc.	297,790	NR	-	NR	501,000	50,493	241,345
Other (Sludge)	-	-	-	-	-	-	-
Other (Misc.)	-	-	-	-	-	-	141,156
TOTAL	$1,079,803	ISD	-	ISD	$2,750,280	$1,292,812	$1,293,567
$/Ton(5)	$1.23	ISD	-	ISD	$0.725	$0.058	$1.64

TABLE VIII-1
EFFLUENT TREATMENT COSTS
IRONMAKING BLAST FURNACES
PAGE 2

Plant Code Reference No.	-- 0060	-- 0112	-- 0320	-- 0384A	-- 0684F			-- 0868A	-- 0920B
					Nos. 1 & 4	Nos. 5 & 6	Total		
Initial Investment Cost	$2,963,000(8)	$7,384,290	14,806,000	$20,896,310	$12,191,480	$10,315,160	$22,506,640	$4,706,780	$5,171,700
Annual Costs									
Capital(1)	$266,374	-	1,331,060	$1,878,578	-	-	-	-	$464,936
Cost of Capital	-	$553,822(4)	--	$975,318(4)	$825,213(4)	$1,800,531(4)		$404,373(7)	-
Depreciation	-	410,238(4)	-	812,765(4)	687,678(4)	1,500,443(4)		188,271(4)	-
Operation and Maintenance	ISD	1,006,686	ISD	763,288	700,941	698,468	1,399,409	786,132	107,328
Energy, Power, Chemicals, etc.	ISD	91,172	ISD	848,139	502,394	327,698	830,092	467,004	212,592
Other (Sludge)	-	-	-	438,084	206,512	124,994	331,506	58,452	-
Other (Misc.)	-	98,860	-	187,494	-	-	-	71,547	-
TOTAL	ISD	$2,160,778(6)	ISD	$4,115,583	$3,197,930	$2,664,051	$5,861,981	$1,975,779	$784,856
$/Ton(5)	ISD	$1.14(6)	ISD	$0.754	$3.067	$1.870	$2.376	$1.668	$0.892

NR : No cost data received.
ISD: Data which was supplied is insufficient to establish blast furnace wastewater treatment costs.

* Confidential

(1) The capital charge is based upon the formula, initial investment x 0.0899.
(2) These reported costs most likely reflect an inability to break out the desired costs from the entire gas washer system.
(3) The total cost over a number of years was only supplied. Based on a review of equipment installation dates as presented in the 308 the following apportionment was devised, 75% of total cost in 1951 and 25% in 1971.
(4) Company basis capital cost and depreciation amounts.
(5) Tonnage is based on plant visit or detailed questionnaire data.
(6) This cost does not include operating expense of picking up drip legs (current construction) but this would be small in comparison to other costs.
(7) This value represents Total Fixed Costs as supplied by the company. This amount includes insurance, capital cost, etc. but not taxes or depreciation.
(8) Does not include all costs (as stated by company).

TABLE VIII-2

EFFLUENT TREATMENT COSTS
FERROMANGANESE BLAST FURNACES
(ALL COSTS ARE EXPRESSED IN JULY, 1978 DOLLARS)

Plant Code Reference No.	Q 0112C	025 0112C
Initial Investment Cost	\$3,809,500	\$9,296,200 (2)
Annual Costs		
Capital (1)	\$ 342,474	\$ 835,728
Operation and Maintenance	382,780	491,760
Energy, Power, Chemicals, etc.	151,260	68,844
Other (sludge)	283,118	317,004
TOTAL	\$1,159,632	\$1,713,336
\$/Ton	\$ 5.47	\$ 7.27

---

(1) The capital charge is based upon the formula, 0.0899 x initial investment.

(2) Inasmuch as a portion of the investment cost covers the period 1964-68, the cost for this period was broken down to 65 percent in 1964 and 35 percent in 1967 based on 308 information.

TABLE VIII-3

CONTROL AND TREATMENT TECHNOLOGIES IRONMAKING SUBCATEGORY

C&TT Step	Description	Implementation Time (months)	Land Usage (ft^2)
A	THICKENER - This step provides suspended solids removal as a result of sedimentation. Significant reductions in the levels and loads of those pollutants (principally toxic metals) in the particulate form are also provided.	15 to 18	69,000
B	FLOCCULATION WITH POLYMER - This step enhances suspended solids and particulate pollutant removal performance in Step A.	6	1000
C	VACUUM FILTER - Vacuum filters are used to dewater and reduce the volume and mass, of the sludges removed from the sedimentation steps. The filtrate is re-turned to the treatment system influent.	15 to 18	20,000
D	COOLING TOWER - This C&TT step reduces the recycled wastewater heat load.	18 to 20	2500
E	RECYCLE - At BPT ninety-six percent of the cooling tower effluent is returned to the process. At BAT levels of treatment, ninety-eight percent of the cooling tower effluent is returned to the process.	12 to 14	3000
F	DISPOSAL ON SLAG - Blowdown from the cooling tower, Step E, is disposed of on slag. The recycle system blowdown must be restricted to that volume which can be evaporated on slag.	6 to 8	No additional requirements.
G	PRESSURE FILTRATION - Filters provide additional suspended solids and particulate pollutant removal.	15 to 18	625
H	NEUTRALIZATION WITH LIME - Lime is added for toxic metals removal and pH control. This enhanced capability results from the removal, by sedimentation, of metallic hydroxide precipitates.	12	625

TABLE VIII-3
CONTROL AND TREATMENT TECHNOLOGIES
IRONMAKING SUBCATEGORY
PAGE 2

C&TT Step	Description	Implementation Time (months)	Land Usage (ft^2)
I	INCLINED PLATE SEPARATOR - This component provides additional suspended solids and particulate pollutant removal capability as a result of enhanced sedimentation performance.	10 to 12	225
J	NEUTRALIZATION WITH ACID - Prior to discharge, acid is added (as needed) to the treated effluent in order to assure that the treated effluent pH is within the neutral range.	8 to 10	625
K	TWO-STAGE CHLORINATION - This C&TT step provides the ability to destroy cyanide and to oxidize phenols and ammonia. The basic processes involved: lime addition; first stage chlorine addition; first step reaction period; acid addition; second stage chlorine addition; and, second stage reaction period.	12 to 15	2500
L	SULFUR DIOXIDE ADDITION - The reducing agent sulfur dioxide is added to the Step K effluent in order to remove essentially all residual chlorine resulting from Step K.	8 to 10	625
M	ACTIVATED CARBON ABSORPTION - Prior to discharge, the treated wastewaters (the filter effluent) from BAT Alternative No. 5 are passed through a column of granular activated carbon in order to remove residual levels of toxic organic pollutants. This removal is achieved by adsorption on the activated carbon.	15 to 18	625
N	EVAPORATION - The effluent from the BPT treatment system model is delivered to a vapor decompression evaporation system. This system produces a distillate quality effluent and crystalline solids.	18 to 20	1000
O	RECYCLE - The effluent of Step N is returned to the process as a makeup water supply.	12 to 14	625

TABLE VIII-4

BPT TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory : Ironmaking

Model Size-TPD : 6,000
Oper. Days/Year: 365
Turns/Day : 3

C&TT Step	A	B	C	D	E	Total
Investment ($ x 10^{-3})	4,365.0	135.0	1,691.0	1,901.0	1,450.0	9,542.0
Annual Costs ($ x 10^{-3})						
Capital	392.4	12.1	152.0	170.9	130.4	857.8
Operation & Maintenance	152.8	4.7	59.2	66.5	50.8	334.0
Land	2.8		1.1	0.2		4.1
Sludge Disposal(1)			597.3			597.3
Hazardous Waste Disposal						
Oil Disposal						
Energy and Power	4.9	2.1	106.6	130.6		244.2
Steam						
Waste Acid						
Crystal Disposal						
Chemical		210.2				210.2
TOTAL	552.9	229.1	916.2	368.2	181.2	2,247.6
Credits						
Scale						
Sinter			678.6			678.6
Oil						
Acid Recovery						
TOTAL CREDITS			678.6			
NET TOTAL(1)	552.9	229.1	237.6	368.2	181.2	1,569.0(1)

KEY TO C&TT STEPS

A: Thickening
B: Coagulant Aid Addition
C: Vacuum Filtration
D: Cooling Tower
E: Recycle

---

(1) These model costs incorporate the effects of both sludge disposal and sinter recovery. The net total annual costs for operations which practice sinter recovery would not include sludge disposal expenditures and, therefore, are less than the net total shown above. In these cases, the net total annual cost would be 971.7.

TABLE VIII-5

BAT/PSES/PSNS/NSPS TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS

Subcategory: Ironmaking

Model Size - TPD: 6,000
Oper. Days/Year : 365
Turns/Day : 3

C&TT Step	Total BPT	BAT Alternative 1		BAT Alternative 2		BAT Alternative 3			
		F	Total	G	Total	H	I	J	Total
Investment ($ x 10^{-3})	9,542.0	172.0	172.0	285.5	285.5	94.0	236.0	54.2	384.2
Annual Costs ($ x 10^{-3})									
Capital	857.8	15.5	15.5	25.7	25.7	8.5	21.2	4.9	34.6
Operation & Maintenance	334.0	6.0	6.0	10.0	10.0	3.3	8.3	1.9	13.5
Land	4.1	0.2	0.2	0.1	0.1	0.1	0.1		0.2
Sludge Disposal	597.3						0.9		0.9
Hazardous Waste Disposal									
Oil Disposal									
Energy & Power	244.2	2.5	2.5	2.4	2.4	1.3	1.0	1.0	3.3
Steam									
Waste Acid									
Crystal Disposal									
Chemical	210.2					2.6		3.8	6.4
TOTAL	2,247.6	24.2	24.2	38.2	38.2	15.8	31.5	11.6	58.9
Credits									
Scale									
Sinter	678.6								
Oil									
Acid Recovery									
TOTAL CREDITS	678.6								
NET TOTAL	1,569.0	24.2	24.2	38.2	38.2	15.8	31.5	11.6	58.9

TABLE VIII-5
BAT/PSES/PSNS/NSPS TREATMENT MODEL COSTS: BASIS 7/1/78 DOLLARS
PAGE 2

	BAT Alternative 4				BAT Alternative 5 Alt. 4 Plus:			BAT Alternative 6		
C&TT Step	K	I	L	Total	G	M	Total	N	O	Total
Investment ($ x 10^{-3})	463.0	236.0	85.1	784.1	285.5	2,079.0	3,148.6	4,303.3	104.2	4,407.5
Annual Costs ($ x 10^{-3})										
Capital	41.6	21.2	7.7	70.5	25.7	186.9	283.1	386.9	9.4	396.3
Operation & Maintenance	16.2	8.3	3.0	27.5	10.0	72.8	110.3	150.6	3.6	154.2
Land	0.2	0.1	0.1	0.4	0.1	0.1	0.6	0.1	0.1	0.2
Sludge Disposal		2.8		2.8			2.8			
Hazardous Waste Disposal										
Oil Disposal										
Energy & Power	6.4	1.0	1.1	8.5	2.4	8.2	19.1	349.5		349.5
Steam										
Waste Acid										
Crystal Disposal										
Chemical	123.8*		2.9	126.7			126.7			
TOTAL	188.2	33.4	14.8	236.4	38.2	268.0	542.6	887.1	13.1	900.2
Credits										
Scale										
Sinter										
Oil										
Acid Recovery										
TOTAL CREDITS										
NET TOTAL	188.2	33.4	14.8	236.4	38.2	268.0	542.6	887.1	13.1	900.2

KEY TO TREATMENT ALTERNATIVES

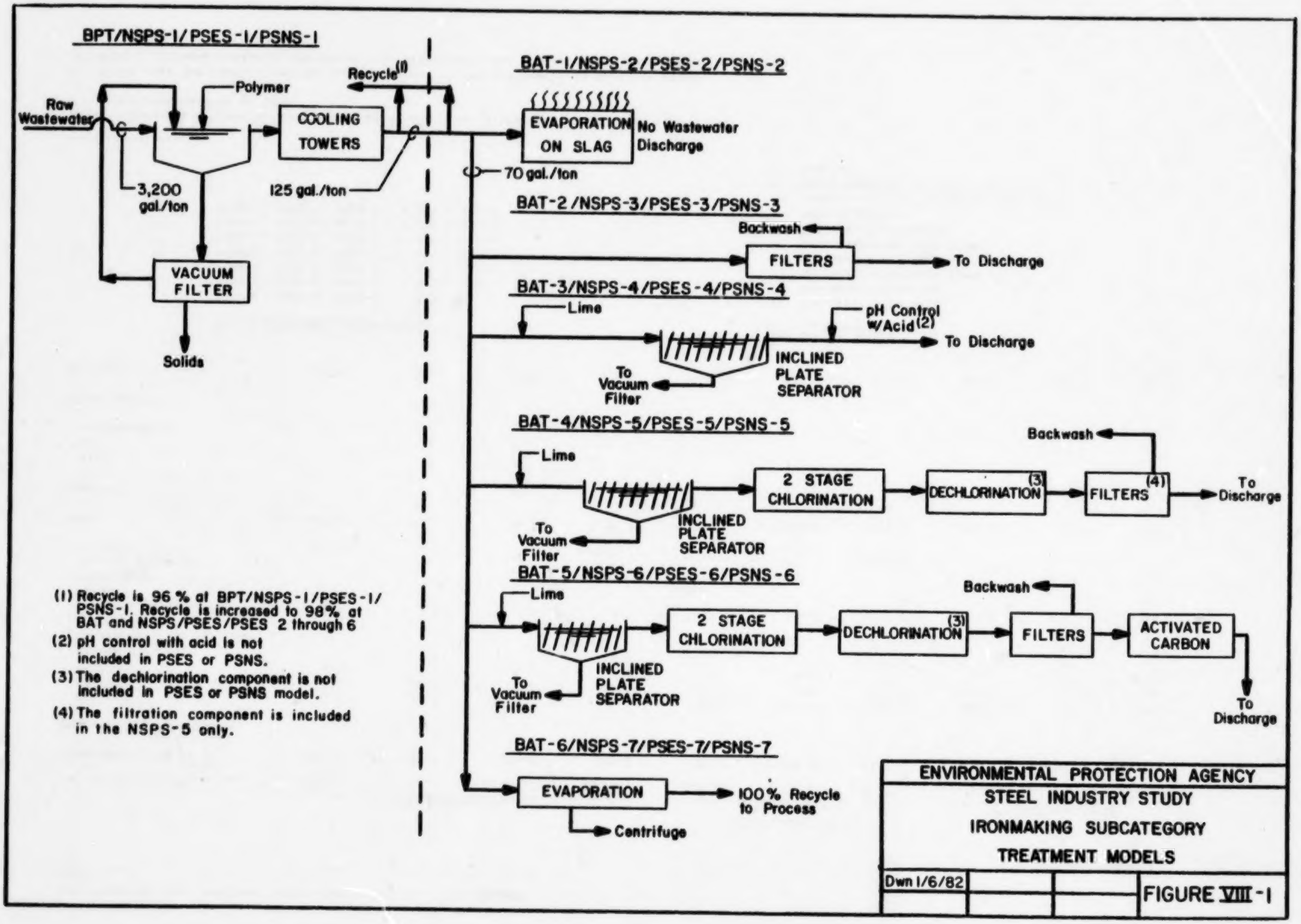
PSES-1, PSNS-1, NSPS-1 = BPT
PSES-2, PSNS-2, NSPS-2 = BPT + BAT-1
PSES-3, PSNS-3, NSPS-3 = BPT + BAT-2
PSES-4, PSNS-4, NSPS-4 = BPT + BAT-3
PSES-5, PSNS-5, NSPS-5(1) = BPT + BAT-4
PSES-6, PSNS-6, NSPS-6 = BPT + BAT-5
PSES-7, PSNS-7, NSPS-7 = BPT + BAT-6

KEY TO C&TT STEPS

F: Evaporation on Slag
G: Pressure Filtration
H: Neutralization with Lime
I: Inclined Plate Separation
J: Neutralization with Acid
K: 2-Stage Chlorination
L: Dechlorination
M: Granular Activated Carbon Adsorption
N: Vapor Compression Distillation
O: Recycle

Note: Components J (neutralization with acid) and L (dechlorination) are not included in PSES or PSNS.

* Total cost for lime, chlorine, and acid added to the wastewater in separate tanks.
(1) NSPS-5 includes treatment component G in addition to the BPT and BAT-4 components.


BPT/NSPS-1/PSES-1/PSNS-1
Raw Wastewater
Polymer
3,200 gal./ton
COOLING TOWERS
Recycle(1)
125 gal./ton
VACUUM FILTER
Solids
BAT-1/NSPS-2/PSES-2/PSNS-2
EVAPORATION ON SLAG
No Wastewater Discharge
70 gal./ton
BAT-2/NSPS-3/PSES-3/PSNS-3
Backwash
FILTERS
To Discharge
BAT-3/NSPS-4/PSES-4/PSNS-4
Lime
pH Control w/Acid(2)
To Discharge
INCLINED PLATE SEPARATOR
To Vacuum Filter
BAT-4/NSPS-5/PSES-5/PSNS-5
Lime
2 STAGE CHLORINATION
DECHLORINATION(3)
FILTERS(4)
Backwash
To Discharge
INCLINED PLATE SEPARATOR
To Vacuum Filter
BAT-5/NSPS-6/PSES-6/PSNS-6
Lime
2 STAGE CHLORINATION
DECHLORINATION(3)
FILTERS
Backwash
ACTIVATED CARBON
To Discharge
INCLINED PLATE SEPARATOR
To Vacuum Filter
BAT-6/NSPS-7/PSES-7/PSNS-7
EVAPORATION
100% Recycle to Process
Centrifuge

(1) Recycle is 96 % at BPT/NSPS-1/PSES-1/PSNS-1. Recycle is increased to 98% at BAT and NSPS/PSES/PSES 2 through 6

(2) pH control with acid is not included in PSES or PSNS.

(3) The dechlorination component is not included in PSES or PSNS model.

(4) The filtration component is included in the NSPS-5 only.

ENVIRONMENTAL PROTECTION AGENCY
STEEL INDUSTRY STUDY
IRONMAKING SUBCATEGORY
TREATMENT MODELS

Dwn 1/6/82

FIGURE VIII-1

IRONMAKING SUBCATEGORY

SECTION IX

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE

The Agency promulgated the same limitations that were originally promulgated in June 1974 [1]as the Best Practicable Control Technology Currently Available (BPT) for ironmaking operations. The June 1974 development document[2] provides background information on the development of the originally promulgated limitations.

Identification of BPT

A. Ironmaking Blast Furnaces

The BPT model treatment system includes sedimentation in a thickener; coagulant addition for enhanced suspended solids removal performance; sludge dewatering by vacuum filtration; and, recycle through a cooling tower of about 96% of the thickener effluent. The remaining thickener effluent is discharged as blowdown. Figure IX-1 depicts the treatment system described above.

B. Ferromanganese Blast Furnaces

The iron blast furnace BPT model treatment system also applies to ferromanganese blast furnace operations. However, different BPT effluent limitations were promulgated to account for the higher blowdown concentrations of pollutants limited at BPT for ferromanganese furnaces.

Table IX-1 summarizes the characteristics of ironmaking and ferromanganese blast furnace raw process wastewaters. The 30-day average BPT effluent limitations are as follows:

---

[1] Federal Register; Friday, June 28, 1974; Part II, Environmental Protection Agency: Iron and Steel Manufacturing Point Source Category; Effluent Guidelines and Standards; Pages 24114-24133.

[2] EPA-440/I-74-a, Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Steelmaking Segment of the Iron and Steel Manufacturing Point Source Category.

	kg/kkg of Product (lb/1000 lb of Product)	
Pollutants	Ironmaking Blast Furnaces	Ferromanganese Blast Furnace
Total Suspended Solids	0.0260	0.1043
Ammonia (N)	0.0535	0.4287
Cyanide (Total)	0.0078	0.1563
Phenols (4AAP)	0.0021	0.0208
pH (Units)	Within the range 6.0-9.0	

The maximum daily effluent limitations are three times the average values presented above.

Selection of BPT Limitations

A. Treatment System

As noted in Section VII, the Agency found that each of the components included in the BPT model treatment system is presently in use at most blast furnace sites. Given the widespread use of these components, the Agency believes that the BPT model treatment system is appropriate.

B. Model Treatment Flow Rates

The Agency retained the BPT model treatment system effluent flow rate of 125 gal/ton used to develop the previously promulgated BPT limitations. As shown in Table IX-2, this flow is demonstrated at several plants.

C. Effluent Quality

The Agency also retained the BPT model treatment system effluent quality from the prior regulation. These concentrations are as follows:

	30-Day Average	Daily Maximum
Total Suspended Solids	50 mg/l	150 mg/l
Ammonia-N	120	375
Total Cyanide	15	45
Phenols(4AAP)	4	12

As shown in Section VII, these concentrations are readily demonstrated at plants with recycle systems in place.

D. Justification of BPT Effluent Limitations

Table IX-3 presents effluent data for ironmaking operations sampled by the Agency and data from D-DCP respondents which support the BPT limitations. The only sampled plants or D-DCP respondents which did not comply with the BPT limitations are those which had once-through treatment systems. The Agency could not fully evaluate the compliance status of a few plants because of insufficient data supplied by the industry. These plants are not listed in the table. Although, alkaline chlorination is used at a few of the plants that comply with the BPT limitations, nearly all plants achieve the BPT limitations with no treatment of the recycle system blowdown. The sampled plants not included in Table IX-3 could comply with the BPT limitations if recycle systems were installed. Recycle systems have been installed at many of these plants since these data were collected. The Agency estimates that about ninety percent of the currently operating ironmaking operations are in compliance with the BPT limitations.

TABLE IX-1
RAW WASTEWATER CHARACTERISTICS
IRONMAKING SUBCATEGORY

(All values expressed in mg/l unless otherwise noted)

	IRON MAKING BLAST FURNACES (1)	FERROMANGANESE BLAST FURNACE (2)
FLOW (gal/ton)	3200	11,540
AMMONIA (as N)	10	711
CYANIDE (Total)	10	692
PHENOLS (4AAP)	2.5	6.5
SUSPENDED SOLIDS	1900	4160
pH (Units)	6-10	8.8-11.3

(1) Raw wastewater quality reflects the discharge from a once-through system.

(2) Data are based upon one plant which was operating at the time of sampling. These values reflect the increases due to recycle.

TABLE IX-2

BPT EFFLUENT FLOW JUSTIFICATION IRONMAKING SUBCATEGORY

Plant Reference Code	Discharge Flow (gal/ton)	Operating Mode	Source of Data
0112	71	RTP-96	D-DCP
0112D	73	RTP-97	VISIT
0448A	101	RTP-97	VISIT
0528A	66	RTP-97	Request(1)
0684F	61	RTP (>90)	Request(2)
0732A	<10(3)	RTP-(<100)	VISIT
0856I	60.7	RTP-(>98)	Request(1)
0856N	76.5	RTP-(>90)	Request(1)
0860B	45.5	RTP-(>90)	Request(1)
0860H -	120	RTP and RUP-96	DCP
0868A-02	122	RTP and RUP-96	D-DCP
0920B	83	RTP and RUP-96	D-DCP
0948A-02	96	RTP-90	DCP
0948C	85	RTP and RUP-96	DCP

---

(1) These data represent averages of all long-term data submitted by these plants.

(2) This value is an average of long-term data submitted by this plant. These data reflect the effects of discharge flow reduction efforts.

(3) Estimated value.

TABLE IX-3

JUSTIFICATION OF BPT EFFLUENT LIMITATIONS (kg/kkg)
IRONMAKING SUBCATEGORY

	Ammonia (as N)	Cyanide (T)	Phenols (4AAP)	TSS	pH	C&TT Components
Iron Making Blast Furnaces						
BPT	0.0535	0.00780	0.00210	0.0260	6.0-9.0	T,FLP,VF,CT, RTP-96
Plants						
L (0946A)	0.0186	0.000173	0.000363	NJ	7.6	T,CLA,SS, Filters,RTP-37
N (0448A)	NJ	0.00724	0.000015	0.0163	6.7-8.1	T,CT,SL,RTP-97 ES
O (0060F)	0.0356	0.00468	0.000004	0.0199	8.0	T,FLP,CT,VF, RTP-97,ES
026 (0112D)	0.0122	0.000014	0.000008	0.0198	7.3-7.5	T,FLP,VF,NA CT,RTP-95
028 (0684H)	0.0125	0.000178	0.00157	NJ	8.2-8.8	A,CLA,FLP,CL, CT,FLFC,NA, RTP-92
030 (0112)	0.0437	0.00666	0.000066	0.0174	7.2-7.5	T,FLP,NA,VF, CT,RTP(Unk)
0684H(1)	0.0117	0.000750	NA	0.0161	8.6	A,NL,FLP,CLA CL,VF,CT
Ferromanganese Blast Furnace						
BPT	0.429	0.156	0.0208	0.104	6.0-9.0	See comments in Section IX.
025 (0112C)	No discharge of process wastewater pollutants.					CL,T,VF, CT,RTP-100

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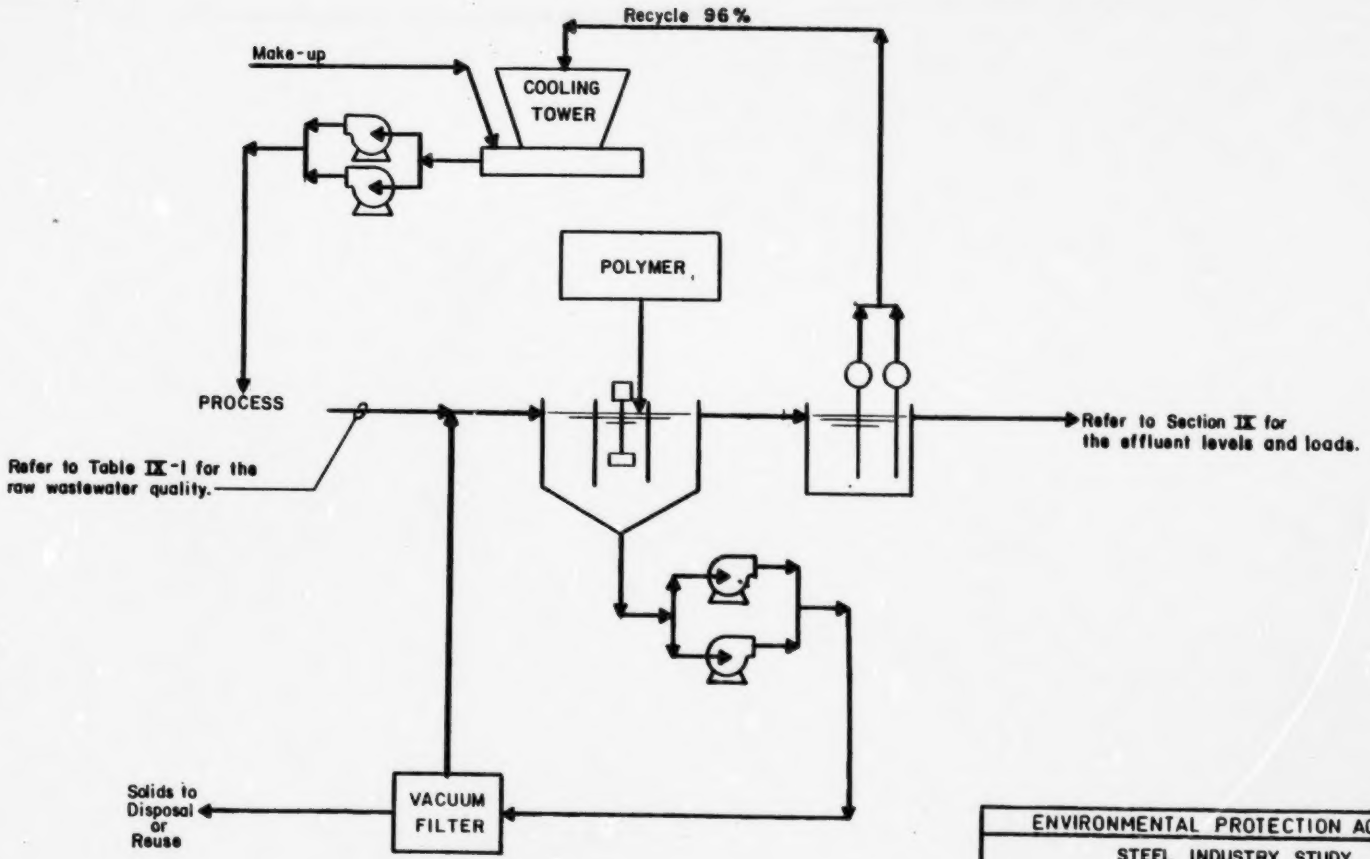
(1) Based on D-DCP analytical data
NA: No analysis performed
NJ: Not justified

Note: For definitions of C&TT Codes, see Table VII-1.


Recycle 96%
Make-up
COOLING TOWER
POLYMER
PROCESS
Refer to Table IX-1 for the raw wastewater quality.
Refer to Section IX for the effluent levels and loads.
Solids to Disposal or Reuse
VACUUM FILTER

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
IRONMAKING SUBCATEGORY
BPT TREATMENT MODEL

DWN. 5/31/78
Rev. 7/25/79

FIGURE IX-1

IRONMAKING SUBCATEGORY

SECTION X

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE

Introduction

This section identifies six BAT alternative treatment systems considered by the Agency in developing the BAT effluent limitations. Since there are no ferromanganese blast furnaces in operation or scheduled for operation the Agency has not promulgated BAT effluent limitations for ferromanganese blast furnaces. Should any ferromanganese blast furnaces operate, appropriate BAT effluent limitations should be established on a case by case basis using "best professional judgment". In those instances, the model BPT and BAT treatment systems for iron blast furnaces should be considered. The only ferromanganese blast furnace in operation at the time of the Agency's monitoring programs was operating with no discharge. The technologies included in the BAT alternative treatment systems are capable of attaining similar pollutant effluent levels for both iron and ferromanganese blast furnace operations. However, for the BAT model treatment system, operating costs for ferromanganese treatment systems are likely to be higher due to the higher levels of ammonia-n and total cyanide in wastewaters from ferromanganese operations.

Identification of BAT

Based upon the information presented in Sections III through VIII, the Agency developed the following treatment technologies as BAT alternative treatment systems for the ironmaking subcategory. These treatment systems are designed to be compatible with the BPT model treatment system. Schematic diagrams of the alternatives are presented in Figure VIII-1.

BAT Alternative 1

The blowdown flow is reduced by increasing the recycle rate of the BPT model treatment system to the point where it can be consumed in the quenching (cooling) of blast furnace slag. The treatment system includes a slag pit collection and recycle sump and associated pumps. As all of the blowdown is evaporated, process wastewater pollutants are not discharged into receiving waters.

BAT Alternative 2

The blowdown flow is reduced to 70 gal/ton by increasing the recycle rate of the BPT model treatment system. The reduced blowdown is treated by filtration. Pressure filters are used to reduce toxic metals in the blowdown by removing those toxic metals present in

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particulate form. The filters also remove other pollutants which may be entrained in suspended solids.

BAT Alternative 3

The reduced blowdown flow (70 gal/ton) is treated with lime precipitation and sedimentation. Lime is added to remove both dissolved and particulate toxic metals present in ironmaking wastewaters. The toxic metal hydroxides are gravity settled in an inclined plate separator prior to discharge. Toxic metals as well as other pollutants present in particulate form will also be removed by sedimentation.

BAT Alternative 4

The reduced blowdown (70 gal/ton) is treated with two-stage alkaline chlorination. Lime is added to the blowdown to raise the pH to 10.5 or greater. The toxic metal precipitates and other suspended solids formed by lime addition are removed in inclined plate separators prior to alkaline chlorination. Chlorine is added to the first reactor to convert the cyanides to cyanates and to oxidize ammonia-N and phenolic compounds. As the wastewaters leave the first reactor, acid is added to reduce the pH to 8.5. Additional chlorine is added in the second reactor to complete the oxidation of cyanides, as well as residual ammonia-N and phenolic compounds. The effluent is then dechlorinated with appropriate reducing agents prior to discharge.

BAT Alternative 5

Additional treatment of the effluent from BAT Alternative 4 is provided by adsorption on activated carbon. Activated carbon will remove residual levels of toxic organic pollutants which may be present in the wastewater.

BAT Alternative 6

The blowdown from the recycle system (70 gal/ton) is processed by vapor compression distillation. The high purity water (steam condensate) is returned to the recycle system resulting in zero discharge of wastewater.

Except for vapor compression distillation, the treatment technologies described above are in full scale use at one or more blast furnace wastewater treatment systems, or demonstrated on the basis of pilot plant studies in this subcategory. The applicability of each treatment system is reviewed below.

The pollutants selected for limitation and the effluent limitations for each alternative are presented in Table X-1. The Agency's selection of pollutants for which BAT limitations have been promulgated is based upon the following considerations: the relative level, discharge load, and environmental impact of each pollutant; the need to establish practical monitoring requirements; and, to facilitate co-treatment of ironmaking and sintering wastewaters, a common practice in the industry.

Treatment for the selected pollutants will generally result in a similar or greater degree of treatment for pollutants chemically related to the selected pollutants and found at lower levels. For example, nine toxic metals were identified in the process wastewaters from blast furnace operations at concentrations greater than 0.010 mg/l. However, the Agency has promulgated BAT limitations for only lead and zinc. Significant removal of the other metals will occur in conjunction with the treatment and control of these metals.

Rationale for the Selection of BAT

Treatment Technologies

Recirculation of treated wastewater is one of the major components of the BAT model treatment system. The recirculation rate of the BPT model treatment system is increased from 96% (125 gal/ton) to 98% (70 gal/ton blowdown). Recycle of blast furnace wastewaters is widely demonstrated in the industry. The 70 gal/ton blowdown rate is also demonstrated and is discussed in detail below. In the first alternative, the blowdown is reduced to the point where it can be consumed to quench (cool) slag. Approximately 60% of the blast furnaces have adjacent slag operations. This practice is demonstrated in the industry (Plants 0060F, 0448A, 0860H) and provides a fairly inexpensive approach to achieve the BAT limitations. Filtration is used to treat wastewaters from three blast furnace operations (Plants 0584C, 0860B and 0946A. Precipitation and alkaline chlorination are used in several blast furnace wastewater treatment systems (0320, 0504C, 0860B). The primary purpose of alkaline chlorination is the oxidation of ammonia-N, cyanide, phenolics, and other toxic organic pollutants. The fifth BAT alternative includes activated carbon for the removal of residual levels of toxic organic pollutants from the effluent of BAT Alternative 4. This is demonstrated on a full-scale basis at Plant 0860B in this subcategory.

Model Flow Rate

The Agency has retained the BPT applied flow of 13,344 l/kkg (3200 gal/ton) for use in the BAT alternative treatment systems. The discharge flow of 292 l/kkg (70 gal/ton) used to develop the proposed BAT limitations has been retained. In the draft development document the Agency cited data for Plant 0112 that indicate 70 gal/ton is an achievable blowdown rate for blast furnace recycle systems. The industry noted that longer term data for that plant indicate the blowdown rate for this operation is about 78 gal/ton, and that monthly average flows during the period of record exceed 130 gal/ton. The industry contends that flows less than 70 gal/ton cannot be maintained for long periods of time because of the build-up of dissolved solids which can lead to an increased potential for stress corrosion and mineral scaling. The Agency disagrees that 70 gal/ton is not sustainable on a long term basis. Data for Plant 0112 show that 70 gal/ton has been maintained for long periods of time without fouling, scaling, or plugging problems. The Agency notes that the blowdown rate at this plant is controlled to maintain cyanide discharges below certain levels and that dissolved solids or other indices relating to fouling or scaling are not used to control the blowdown rate. Thus, the Agency believes a blowdown rate of 70 gal/ton is achievable at this plant. The Agency solicited data for other well-operated blast furnace recycle systems. These data are shown below:

Plant	Period Covered by Date	Average Daily Blowdown (gal/ton)
0528A	January 1978- July 1980	68.5
0856I	November 1979- May 1981	60.7
0860B	October 1980- December 1980	45.5

Based upon these data; the performance data for Plant 0112 noted above; the performance of one of the two blast furnace recycle systems at Plant 0684F; and, the performance at Plants 0060F, 0448A, and 0860H where blast furnace blowdowns are consumed on slag and other sources, the Agency believes that 70 gal/ton is an achievable blowdown rate for all blast furnaces. These plants are typical of those in the industry, are located in different geographic areas, use different raw materials, and are operated by different companies. Aside from the demonstration of the 70 gal/ton blowdown rate noted above, one major steel company suggested the Agency use a blowdown rate of 35 gal/ton to establish BAT effluent limitations.

Wastewater Quality

The average and maximum effluent concentrations included in each BAT treatment alternative are presented in Table X-1. No data are presented for Alternatives 1 and 6 since these alternatives result in zero discharge. The effluent levels for Alternatives 2 through 5 are discussed below.

Ammonia-N

Alternatives 2 and 3 do not provide for treatment of ammonia-N. Thus, the discharge of ammonia-N from these systems is the same as that from the BPT recycle system.

To some extent, ammonia-N will concentrate in recycle systems as the blowdown rate is brought under hydraulic control and reduced. However, the discharge loading will decrease with decreasing blowdown rate rather than remain the same. Thus, there is an advantage to minimizing blowdown rate. The investment costs of the treatment facilities will be reduced as well as the costs of chemicals required for blowdown treatment.

Alternatives 4 and 5 include alkaline chlorination for treatment of ammonia-N, total cyanide, phenols (4AAP), and other toxic organic pollutants. The proposed BAT ammonia-N limitation is based upon a concentration of 1.0 mg/l obtained from pilot plant studies. The industry submitted data for a full scale system (Plant 0860B) that suggests a BAT limitation based upon 10 mg/l might be more appropriate. The Agency solicated long term data for this plant. Based on its analysis of these data (Table A-38, Appendix A, Volume I), the Agency concluded that a model effluent concentration of 10 mg/l is appropriate for this technology as these data demonstrate that a well operated system can achieve that value. The data presented in Table X-1 reflect that value. Ammonia-N is not removed by the activated carbon system installed at this plant. Activated carbon system are not capable of ammonia-N removal. Available data demonstrate that the alkaline chlorination process used prior to activated carbon consistently removes ammonia-N to less than 10 mg/l.

Total Cyanide

Alternatives 2 and 3 do not include treatment for total cyanide. Thus, the level of discharge was set at the level determined from BPT recycle system blowdowns, or about 5 mg/l. This value is supported by the data presented in Section VII.

For Alternative 4, the Agency proposed a total cyanide limitation of 1.0 mg/l based upon alkaline chlorination pilot plant data obtained for Plant 0860B. This concentration is demonstrated to be achievable by full scale operation at Plant 0860B and several pilot plant studies conducted at other plants (0112D, 0684F, and 0860H).

Data for Plant 0860B demonstrate that the alkaline chlorination system at this plant consistently removes cyanide to less than 1.0 mg/l and that activated carbon has virtually no effect on cyanide removal. This is also demonstrated at Plant 0684F where activated carbon has virtually no effect on cyanide removal from cokemaking wastewaters.

Phenols (4AAP)

Again, Alternatives 2 and 3 provide no treatment for phenols (4AAP). The effluent levels presented in Table X-1 do not reflect treatment for phenols (4AAP).

For Alternative 4, the Agency proposed a BAT phenols (4AAP) limitation based upon a concentration of 0.1 mg/l. Data obtained from pilot plant studies conducted by the industry at Plant 0860H were used to develop the proposed limitation. The achievability of the BAT limitation is based upon pilot plant and full scale data for Plant 0860B (prior to adsorption on activated carbon) and pilot studies conducted by the industry and the Agency at Plants 0112D, 0684F, and

0860H. The alkaline chlorination system installed at Plant 0860B reduces phenols (4AAP) to the low µg/l range prior to activated carbon treatment. The phenols (4AAP) limitation for Alternative 5 are based upon data from Plant 0860B after activated carbon treatment.

Toxic Metal Pollutants

The Agency reviewed long-term effluent data for filtration systems to determine the toxic metals removal capabilities of these systems (BAT-2) used in similar wastewater treatment applications. Available data indicate a significant portion of the toxic metals in ironmaking wastewaters are in particulate form and can be removed with the suspended solids. In those instances in which the long-term data (noted above and discussed in Volume I) are for ironmaking process wastewater filtration applications, toxic metals removals are generally based upon the degree of suspended solids removal accomplished. The sampled plant monitoring data presented in Section VII demonstrates this general pattern, although the toxic metals effluent concentrations are generally slightly higher than the levels expected strictly on the basis of the metal/TSS ratio.

Sedimentation and filtration are not effective for removing toxic metals dissolved in process wastewaters. In order to remove both the dissolved and particulate fractions of the toxic metals the Agency considered lime precipitation and sedimentation (BAT Alternatives 3, 4 and 5). The presence of dissolved toxic metals in ironmaking wastewaters is related to the nature of the process itself. Some of the volatilized metals, e.g., zinc, are not entirely transformed to oxides and some of the metals may be present as fine particulates measured as dissolved metals by the analytical methodology. The toxic metals effluent levels which can be achieved by lime precipitation, sedimentation, and filtration were determined on the basis of a review of sampled plant monitoring data and data for Plant 0860B. Lead and zinc are the toxic metal pollutants selected for limitation at BAT. The Agency based the lead limitation for Alternatives 3, 4, and 5 on typical BPT blowdown levels and the zinc limitations are based upon data from Plant 0860B.

Sulfide addition was also considered as a means of further reducing the loadings of toxic metals. Because this technology has not been demonstrated in this subcategory and only marginal incremental toxic metals removal can be realized, the Agency did not include sulfide precipitation as a BAT model treatment technology.

Toxic Organic Pollutants

The removal of most toxic organic pollutants is accomplished in BAT Alternative 4 (alkaline chlorination). Activated carbon treatment in BAT Alternative 5 is designed specifically to remove residual levels of those toxic organic pollutants which may be present after treatment in BAT 4. Ironmaking wastewaters treated to the BPT level can contain toxic organic pollutants (phenolic compounds, fluoranthene), that may remain detectable after alkaline chlorination at concentrations at or near treatability levels. Also, application of BAT Alternative 4 could result in the formation of low levels of total halomethanes. However, as noted in Section VII, the Agency believes that the proper application of alkaline chlorination can minimize the formation of trihalomethanes to levels of 0.1 mg/l or less. These low levels are generally not toxic to aquatic life and would not violate proposed drinking water standards if found directly in water supply intakes. Nonetheless, activated carbon treatment was considered as BAT Alternative 5 for toxic organic pollutant removal.

The treatment capabilities of activated carbon are based upon pilot plant studies and effluent data from Plant 0860B. The monitoring data for Plant 0860B and a blast furnace wastewater treatment pilot plant study are presented in Tables VII-8, 9 and VII-11. Plant 0860B and the pilot treatment system included alkaline chlorination and activated carbon treatment components. The data for both of these sources support the attainability of the effluent concentration for phenols (4AAP) included in BAT Alternative 5. An average phenols (4AAP) effluent concentration of less than 0.05 mg/l was achieved with activated carbon during a pilot scale study at plant 0860H.

Total Residual Chlorine

A total residual chlorine limitation of 0.5 mg/l daily maximum is included in BAT 4 and 5 to control excess chlorine resulting from alkaline chlorination. Several reducing agents can be used to destroy excess chlorine. The chemistry of this reaction is well documented throughout the literature and the technology is well demonstrated in other industries as well as in this subcategory at Plant 0584C. Discharge levels of total residual chlorine at plant 0584C are consistently well below 0.5 mg/l.

Effluent Limitations for BAT Alternatives

The effluent limitations for the BAT alternative treatment systems were developed on a mass basis (kg/kkg or lbs/1000 lbs) by considering the model plant effluent flow (70 gal/ton) and the respective BAT effluent concentrations. The effluent limitations presented in Table X-1 for each treatment alternative are on a mass basis, therefore, any combination of effluent flows and concentrations may be used to attain the specified mass limitations.

Selection of a BAT Alternative

The Agency selected BAT Alternative 4, depicted in Figure X-1, as the basis for the BAT limitations. The selection process included a review of the treatability of the toxic pollutants considered for limitation, the effluent levels of these pollutants in each treatment alternative, and the costs of each alternative. With the exceptions of BAT Alternatives 1, 5, and 6, the Agency determined that BAT Alternative 4 provides the most significant benefits with respect to the control of toxic pollutants. The Agency did not select BAT Alternative 1 because slag evaporation cannot be used at all plants;

Alternatives 5 and 6 were not selected on the basis of high incremental costs and minimal additional pollutant removal over that provided by Alternative 4. The pollutants of major concern are ammonia-N, total cyanide, phenols (4AAP), and toxic metals. As shown in Table X-1, the effluent levels of most of these pollutants are reduced only at BAT Alternative 4. The formation of chlorinated organics can be minimized to low levels with properly applied alkaline chlorination systems. Thus, the costly activated carbon step included in BAT Alternative 5 does not achieve significant incremental pollutant removals. The Agency concludes that the effluent reduction benefits associated with alkaline chlorination of blast furnace wastewaters outweigh the negative aspects of the generation of low levels of brominated and chlorinated compounds.

The achievability of the BAT limitations is well demonstrated by the performance of Plant 0860B and by the pilot studies noted above. This comparision is presented in Table X-2. Based upon data and information available to the Agency, it is important that lime or caustic addition and subsequent suspended solids removal precede chlorination, both to insure proper control of pH and toxic metals, and, to minimize the formation of trihalomethanes from the chlorination reaction. The Agency believes that the reduction of ammonia-N, cyanide, and phenols (4AAP) outweighs the formation of halomethanes.

While BAT Alternative 1 is the least expensive alternative and achieves the highest degree of treatment (i.e., no discharge of process wastewater pollutants to navigable wasters), the Agency concluded that this alternative cannot serve as the basis for BAT effluent limitations for the entire subcategory. Due to the methods of slag handling (i.e., remote from the blast furnace) this technology cannot be used at some plants. However, as noted in Section VIII, the Agency believes that BAT Alternative 1 may be selected for many plants as the least expensive means of achieving the BAT limitations. Approximately 60% of the plants have slag operations adjacent to the blast furnaces. The Agency is also aware of other treatment technologies that may be innovative for treating ironmaking wastewaters to achieve the BAT limitations at less cost. These technologies involve reducing recycle system blowdowns to minimum levels with subsequent blowdown treatment.

TABLE X-1

ALTERNATIVE BAT EFFLUENT LIMITATIONS
IRONMAKING SUBCATEGORY

	Alternative No. 1		Alternative No. 2		Alternative No. 3		Alternative No. 4		Alternative No. 5		Alternative No. 6	
	kg/kkg(2)	mg/l	kg/kkg(2)	mg/l	kg/kkg(2)	mg/l	kg/kkg(2)	mg/l	kg/kkg(2)	mg/l	kg/kkg(2)	mg/l
Ammonia (as N)												
Average	-(1)	-	0.0301	103	0.0301	103	0.002921	10	0.002921	10	-(1)	-
Maximum	-	-	0.0902	309	0.0902	309	0.008762	30	0.008762	30	-	-
Cyanide (T)												
Average	-	-	0.00146	5	0.00146	5	0.000292	1	0.000292	1	-	-
Maximum	-	-	0.00292	10	0.00292	10	0.000584	2	0.000584	2	-	-
Phenols (4AAP)												
Average	-	-	0.00117	4	0.00117	4	0.0000292	0.1	0.0000292	0.1	-	-
Maximum	-	-	0.00234	8	0.00234	8	0.0000584	0.2	0.0000584	0.2	-	-
Residual Chlorine(3)												
Maximum	-	-	-	-	-	-	0.000146	0.5	0.000146	0.5	-	-
Lead												
Average	-	-	0.0000730	0.25	0.0000730	0.25	0.0000730	0.25	0.0000730	0.25	-	-
Maximum	-	-	0.000219	0.75	0.000219	0.75	0.000219	0.75	0.000219	0.75	-	-
Zinc												
Average	-	-	0.0000876	0.3	0.0000876	0.3	0.0000876	0.3	0.0000876	0.3	-	-
Maximum	-	-	0.000263	0.9	0.000263	0.9	0.000263	0.9	0.000263	0.9	-	-
Flow												
l/kkg	0	-		292		292		292		292	0	-
gal/ton	0	-		70		70		70		70	0	-

---

(1) Alternatives Nos. 1 and 6 accomplish no discharge of process wastewater pollutants.
(2) kg/kkg (lb/1000 lb) of product.
(3) The limitation for residual chlorine is applicable only when chlorination of ironmaking wastewaters is practiced.

Note: BAT effluent limitations are based upon BAT Alternative No. 4, the selected alternative.

TABLE X-2

JUSTIFICATION OF BAT EFFLUENT LIMITATIONS IRONMAKING SUBCATEGORY

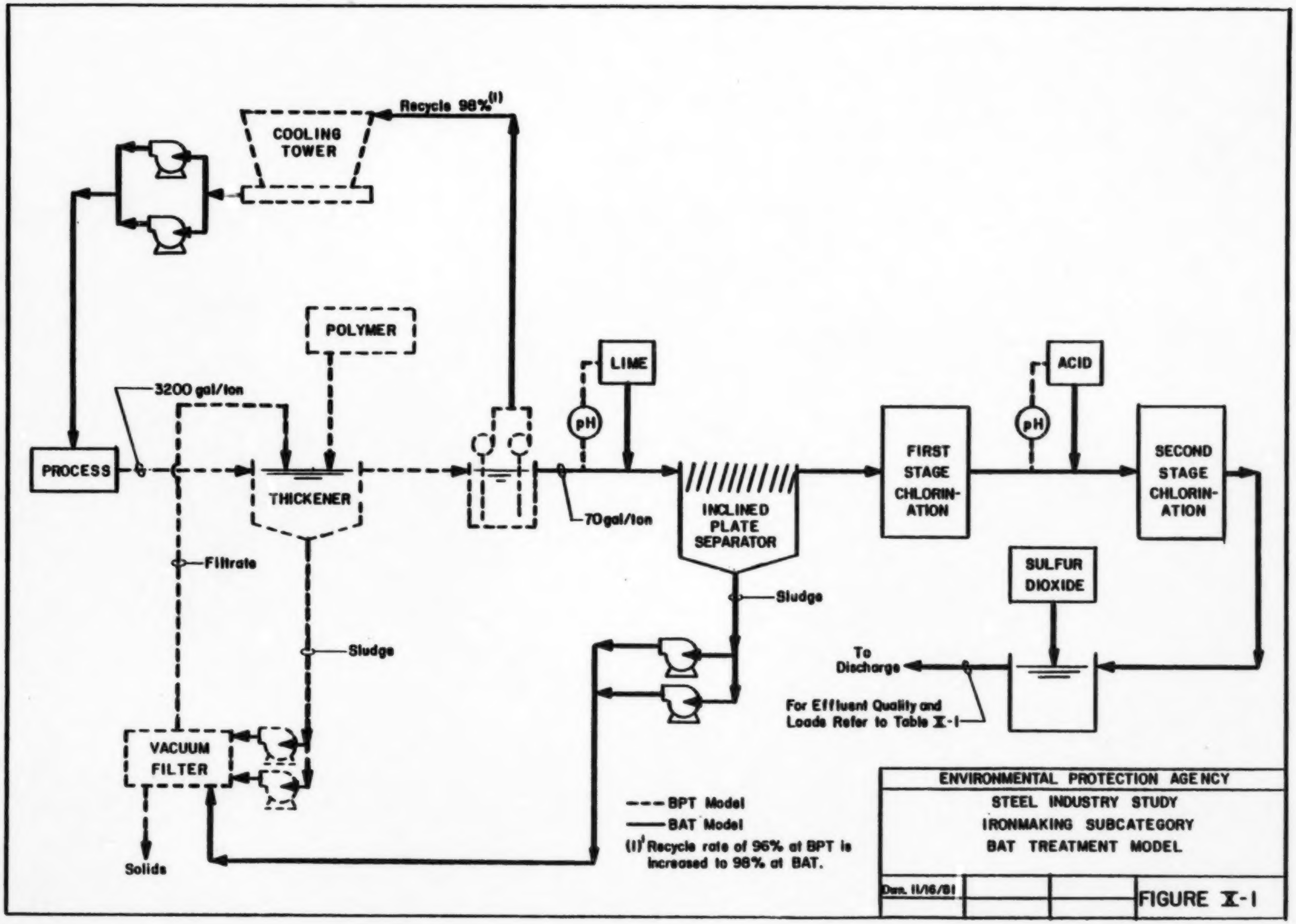
	30-Day Average Limitations				
BAT Limitations	Ammonia-N (lb/day)	Cyanide (lb/day)	Phenols-4AAP (lb/day)	Lead (lb/day)	Zinc (lb/day)
Ironmaking[1]	120.4	12.0	1.2	3.0	3.6
Sintering	166.3	16.6	1.7	4.2	5.0
Total	286.7	28.6	2.9	7.2	8.6
Current Discharge of Plant 0860B	47.4	0.7	0.1[2]	NA	1.4

---

(1) Sintering Production - 16,600 TPD (from DCP)
Ironmaking Production - 20,611 TPD (from DCP)

(2) Represents activated carbon treatment.

NA: No analyses performed.


Recycle 98%(1)
COOLING TOWER
POLYMER
LIME
ACID
pH
pH
PROCESS
3200 gal/ton
THICKENER
70 gal/ton
INCLINED PLATE SEPARATOR
FIRST STAGE CHLORINATION
SECOND STAGE CHLORINATION
SULFUR DIOXIDE
Filtrate
Sludge
Sludge
To Discharge
For Effluent Quality and Loads Refer to Table X-1
VACUUM FILTER
Solids
BPT Model
BAT Model
(1) Recycle rate of 96% at BPT is increased to 98% at BAT.
Dwn. 11/16/81

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY

IRONMAKING SUBCATEGORY

BAT TREATMENT MODEL

FIGURE X-1

IRONMAKING SUBCATEGORY

SECTION XI

BEST CONVENTIONAL POLLUTANT CONTROL TECHNOLOGY (BCT)

Introduction

The 1977 Amendments added Section 301(b)(2)(E) to the Act establishing "best conventional pollutant control technology" (BCT) for discharges of conventional pollutants from existing industrial point sources. Conventional pollutants are those defined in Section 304(a)(4) [biochemical oxygen demanding pollutants (BOD_5), total suspended solids (TSS), fecal coliform, and pH], and any additional pollutants defined by the Administrator as "conventional" (oil and grease, 44 FR 44501, July 30, 1979).

BCT is not an additional limitation but replaces BAT for the control of conventional pollutants. In addition to other factors specified in Section 304(b)(4)(B), the Act requires that BCT limitations be assessed in light of a two part "cost-reasonableness" test. American Paper Institute v. EPA, 660 F.2d 954 (4th Cir. 1981). The first test compares the cost for private industry to reduce its conventional pollutants with the costs at publicly owned treatment works for similar levels of reduction in their discharge of these pollutants. The second test examines the cost-effectiveness of additional industrial treatment beyond BPT. EPA must find that limitations are "reasonable" under both tests before establishing them as BCT. In no case may BCT be less stringent than BPT.

EPA published its methodology for carrying out the BCT analysis on August 29, 1979 (44 FR 50732). In the case mentioned above, the Court of Appeals ordered EPA to correct data errors underlying EPA's calculation of the first test, and to apply the second cost test. (EPA had argued that a second cost test was not required.)

EPA has determined that the BAT technology is capable of removing significant amounts of conventional pollutants. However, EPA has not yet proposed or promulgated a revised BCT methodology in response to the American Paper Institute v. EPA decision mentioned earlier. Thus, it is not now possible to apply the BCT cost test to this technology option. Accordingly, EPA is deferring a decision on the appropriate BCT limitations until EPA proposes the revised BCT methodology.

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IRONMAKING SUBCATEGORY

SECTION XII

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF NEW SOURCE PERFORMANCE STANDARDS

Introduction

NSPS are based upon effluent quality achievable through the application of Best Available Demonstrated Control Technology (BDT), processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge of pollutants.

Identification of NSPS

The seven alternative treatment systems developed for NSPS shown in Figure XII-1 are the same as the BPT and BAT alternative treatment systems except filtration is included in the alkaline chlorination alternative. The corresponding effluent standards for these treatment alternatives are presented in Table XII-1. Following is a summary of the treatment technologies included in each NSPS treatment alternative:

NSPS - 1	Gravity sedimentation in a thickener, coagulant aid addition, vacuum filtration of sludges, and recycle through a cooling tower. The recycle system blowdown is discharged without further treatment.
NSPS - 2	The blowdown from the recycle system of NSPS 1 is minimized and evaporated on slag.
NSPS - 3	The recycle system blowdown undergoes filtration prior to discharge.
NSPS - 4	The recycle system blowdown is treated by lime precipitation and sedimentation in an inclined plate separator prior to discharge.
NSPS - 5	The recycle system blowdown is treated by lime precipitation and two-stage alkaline chlorination followed by filtration and dechlorination.
NSPS - 6	The effluent from the alkaline chlorination/dechlorination system of NSPS 5 is treated by activated carbon.

NSPS - 7 The recycle system blowdown is processed by vapor compression distillation to achieve zero discharge.

Rationale for Selection of NSPS

Since, except as noted above, the NSPS treatment alternatives are the same as the BPT and BAT treatment systems, the rationale presented in Sections IX and X for these systems is applicable to NSPS.

All of the NSPS treatment schemes are addressed collectively below.

Treatment Technologies

As noted in previous sections, the treatment technologies included in the NSPS alternative treatment systems are demonstrated within the ironmaking subcategory or transferred from other subcategories or related industries (as discussed in Section X). The model treatment technologies are applicable for NSPS for ironmaking wastewaters.

The resulting effluent quality for the NSPS treatment alternatives are presented in Table XII-1. As noted in Section X, the critical pollutants and their effluent levels are based upon the demonstrated capabilities of the wastewater treatment technologies. The effluent levels for suspended solids are based on the performance of Plant 0860B and long term effluent data for clarification and filtration systems applied to ironmaking and other similar wastewaters. The data for Plant 0860B are presented in Table VII-11 while the supplemental long term data analysis is set out in Appendix A of Volume I. These data clearly demonstrate the achievability and appropriateness of the NSPS effluent levels.

Another available technology is nonevaporative cooling of blast furnace wastewaters. This system has the potential for extremely low blowdown rates, or, possibly, zero discharge. This technology is installed at two plants and is currently being installed at others.

Flows

The applied and discharge flows developed for BPT and BAT are applicable and are included in all NSPS treatment alternatives. As noted in Section X, the treatment model effluent (blowdown) flow of 70 gal/ton has been demonstrated on the basis of long-term data at several plants.

Selection of an NSPS Alternative

The Agency selected NSPS 5, depicted in Figure XII-1, as the NSPS model treatment system. This alternative was selected for the same reasons presented in Section X regarding the selection of the BAT model treatment system. However, the NSPS model treatment system includes filtration for additional suspended solids removal. As noted for BAT, evaporation of the recycle system blowdown to extinction on slag is a means of attaining NSPS. The NSPS are presented in Table XII-1 under the heading of NSPS 5.

The NSPS standards are clearly demonstrated by the performance of Plant 0860B. This comparision is presented in Table XII-2.

TABLE XII-1

ALTERNATIVE NSPS
IRONMAKING SUBCATEGORY

	Alternative No. 1		Alternative No. 2		Alternative No. 3		Alternative No. 4		Alternative No. 5		Alternative No. 6		Alternative No. 7	
	kg/kkg(1)	mg/l	kg/kkg(1)	mg/l	kg/kkg(1)	mg/l	kg/kkg(1)	mg/l	kg/kkg(1)	mg/l	kg/kkg(1)	mg/l	kg/kkg(1)	mg/l
Ammonia (as N)														
Average	0.0537	103	-(2)	-	0.0301	103	0.0301	103	0.00292	10	0.00292	10	-(2)	-
Maximum	0.161	309	-	-	0.0902	309	0.0902	309	0.00876	30	0.00876	30	-	-
Cyanide (T)														
Average	0.00782	15	-	-	0.00146	5	0.00146	5	0.000292	1	0.000292	1	-	-
Maximum	0.0235	45	-	-	0.00292	10	0.00292	10	0.000584	2	0.000584	2	-	-
Phenols (4AAP)														
Average	0.00208	4	-	-	0.00117	4	0.00117	4	0.0000292	0.1	0.0000292	0.1	-	-
Maximum	0.00626	12	-	-	0.00234	8	0.00234	8	0.0000584	0.2	0.0000584	0.2	-	-
Residual Chlorine(3)														
Maximum	-	-	-	-	-	-	-	-	0.000146	0.5	0.000146	0.5	-	-
Lead														
Average	0.000261	0.5	-	-	0.0000730	0.25	0.0000730	0.25	0.0000730	0.25	0.0000730	0.25	-	-
Maximum	0.000782	1.5	-	-	0.000219	0.75	0.000219	0.75	0.000219	0.75	0.000219	0.75	-	-
Zinc														
Average	0.000365	0.7	-	-	0.0000876	0.3	0.0000876	0.3	0.0000876	0.3	0.0000876	0.3	-	-
Maximum	0.00110	2.1	-	-	0.000263	0.9	0.000263	0.9	0.000263	0.9	0.000263	0.9	-	-
Suspended Solids														
Average	0.0260	50	-	-	0.00438	15	0.00730	25	0.00438	15	0.00438	15	-	-
Maximum	0.0780	150	-	-	0.00117	40	0.0204	70	0.00117	40	0.0117	40	-	-
pH	6-9		-	-	6-9		6-9		6-9		6-9		-	-
Oil and Grease(4)														
Average	0.00522	10	-	-	-	-	-	-	-	-	-	-	-	-
Maximum(4)	0.0156	30	-	-	0.00292	10	0.00292	10	0.00292	10	0.00292	10	-	-
Flow														
l/kkg	521		0		292		292		292		292		0	
gal/ton	125		0		70		70		70		70		0	

---

(1) kg/kkg (lb/1000 lb) of product

(2) Alternatives Nos. 2 and 7 result in no discharge of process wastewater pollutants.

(3) The standard for residual chlorine is applicable only when chlorination of ironmaking wastewaters is practiced.

(4) The oil and grease standard is applicable only when ironmaking wastewaters are cotreated with sintering wastewaters. The NSPS for alternatives 3 through 6 are maximum values only.

Note: NSPS is based upon Alternative No. 5, the selected alternative.

TABLE XII-2

JUSTIFICATION OF NSPS
IRONMAKING SUBCATEGORY

NSPS	30-Day Average Standards						
	Total Suspended Solids (lb/day)	Oil and Grease (lb/day)	Ammonia-N (lb/day)	Cyanide (lb/day)	Phenols-4AAP (lb/day)	Lead (lb/day)	Zinc (lb/day)
Ironmaking[(1)]	180.6	120.4	120.4	12.0	1.2	3.0	3.6
Sintering[(1)]	249.3	166.3	166.3	16.6	1.7	4.2	5.0
Total	429.9	286.7	286.7	28.6	2.9	7.2	8.6
Current Discharge of Plant 0860B	53.9	24.6	47.4	0.7	0.1[(2)]	NA	1.4

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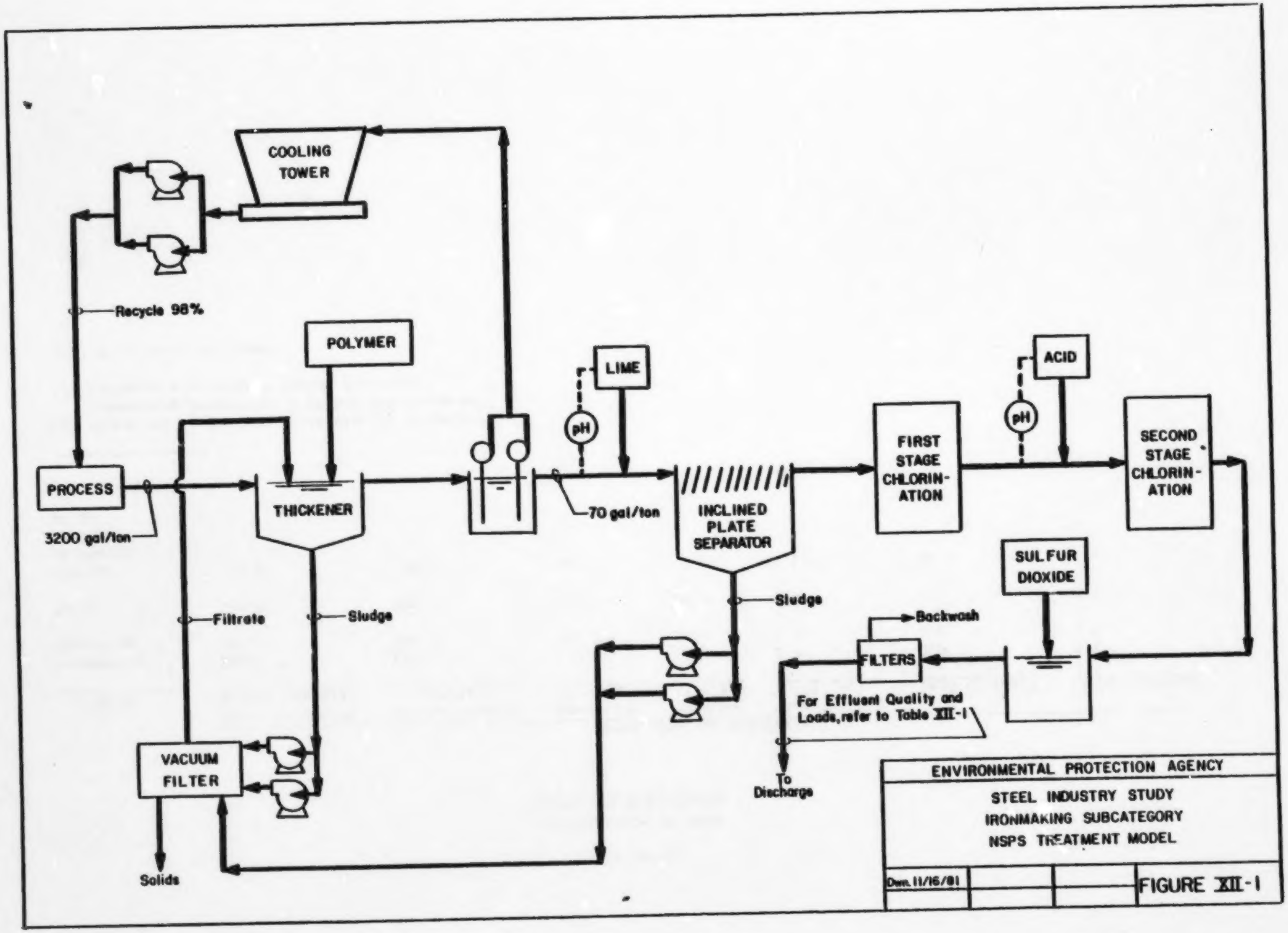
(1) Sintering Production - 16,600 TPD (from DCP)
Ironmaking Production - 20,611 TPD (from DCP)
(2) Represents activated carbon treatment.

NA: No anlyses performed.


COOLING TOWER
Recycle 98%
POLYMER
LIME
pH
ACID
pH
PROCESS
3200 gal/ton
THICKENER
70 gal/ton
INCLINED PLATE SEPARATOR
FIRST STAGE CHLORIN-ATION
SECOND STAGE CHLORIN-ATION
SULFUR DIOXIDE
Filtrate
Sludge
Sludge
Backwash
FILTERS
For Effluent Quality and Loads, refer to Table XII-1
To Discharge
VACUUM FILTER
Solids
Dwn. 11/16/81

ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
IRONMAKING SUBCATEGORY
NSPS TREATMENT MODEL

FIGURE XII-1

SECTION XIII

PRETREATMENT STANDARDS FOR DISCHARGES TO PUBLICLY OWNED TREATMENT WORKS

Introduction

This section presents alternative pretreatment systems for blast furnace operations with discharge to publicly owned treatment works (POTWs). The blowdowns from two ironmaking operations are discharged to POTWs. The general pretreatment and categorical pretreatment standards applying to ironmaking operations are discussed below.

General Pretreatment Standards

For detailed information on Pretreatment Standards refer to 46 FR 9404 et seq, "General Pretreatment Regulations for Existing and New Sources of Pollution," (January 28, 1981). See also 47 FR 4518 (February 1, 1982). In particular, 40 CFR Part 403 describes national standards (prohibited and categorical standards), revision of categorical standards through removal allowances, and POTW pretreatment programs.

In establishing pretreatment standards for ironmaking operations, the Agency considered the objectives and requirements of the General Pretreatment Regulations. The Agency determined that untreated discharges of ironmaking wastewaters to POTWs would result in pass through of toxic pollutants.

Identification of Pretreatment Alternatives

The PSES and PSNS alternative treatment systems are identical to the BPT and the BAT alternative treatment systems presented in Sections IX and X. These alternatives are shown in Figure VIII-1. Reference is made to Sections X and XII for a discussion of these treatment systems.

Following is a summary of the treatment system components included in each pretreatment alternative:

PSES/PSNS Alternative 1 - Coagulant aid addition, gravity sedimentation in a thickener, vacuum filtration of sludges, recycle (98%) through a cooling tower. The blowdown from the recycle system is discharged without further treatment.

PSES/PSNS Alternative 2 - The recycle system blowdown from Alternative 1 is completely evaporated on slag.

PSES/PSNS Alternative 3 - This alternative is the same as Alternative 2 except that the blowdown is treated by filtration and discharged, rather than evaporated on slag.

PSES/PSNS Alternative 4 - The recycle system blowdown is treated by lime precipitation and sedimentation in an inclined plate separator prior to discharge.

PSES/PSNS Alternative 5 - The recycle system blowdown is treated by two-stage alkaline chlorination prior to discharge.

PSES/PSNS Alternative 6 - The effluent from the alkaline chlorination system of Alternative 5 is further treated by filtration and activated carbon.

PSES/PSNS Alternative 7 - The recycle system blowdown is processed by vapor compression distillation to achieve zero discharge.

The intent of the pretreatment standard is to provide for reductions in the effluent levels of ammonia, cyanide, toxic metals, and toxic organic pollutants. Recycle of the wastewaters will substantially reduce the pollutant loads discharged from blast furnaces. Evaporation on slag, although not universally applicable, eliminates the discharge of the blowdown. Filtration and lime precipitation are included for the purpose of reducing toxic metals effluent levels. As noted in Section X, the major portion of the toxic metals waste load is entrained in the particulate matter suspended in the process wastewaters. Consequently, suspended solids control by sedimentation and filtration will result in the removal of a substantial portion of the toxic metals load. Lime precipitation will provide additional toxic metals removal and load reductions through precipitation of those toxic metals dissolved in the wastewaters. Two-stage alkaline chlorination technology is included to remove ammonia-N, cyanide, and phenols (4AAP). Activated carbon provides additional removal of toxic organics that may remain in the wastewater after alkaline chlorination.

Table XIII-1 presents the effluent standards for each alternative for those pollutants considered for regulation.

Selection of Pretreatment Alternatives

PSES/PSNS Alternative 5 was selected as the basis for the promulgated PSES and PSNS. As noted earlier, PSES/PSNS Alternative 5 is equivalent to the selected BAT alternative for ironmaking operations. This alternative provides for the greatest removal of toxic and nonconventional pollutants found in ironmaking wastewaters without the high costs of activated carbon and zero discharge technologies included in Alternatives 6 and 7, respectively.

Aside from recycle (PSES/PSNS Alternative 2), there is no specific treatment in the BPT system for toxic and nonconventional and pollutants; nor is there any in PSES/PSNS Alternatives 3 and 4. Thus, the Agency believes PSES/PSNS Alternative 5 is the appropriate model technology for PSES/PSNS. The removal rates of toxic and nonconventional pollutants from untreated ironmaking wastewaters for PSES/PSNS Alternative 5 are compared to the POTW removal rates for these pollutants:

Pollutant Removal Rate Comparison

	PSES/PSNS Model	Actual POTW
Ammonia-N	99.3%	0%
Cyanide	99.9%	52%
Lead	99.9%	47%
Zinc	99.9%	65%

As shown above, the selected PSES/PSNS alternative will prevent pass through of toxic and nonconventional pollutants found in ironmaking wastewaters to a significantly greater degree than would occur if ironmaking wastewaters were discharged untreated to POTWs. The achievability of these standards is demonstrated in Table X-2. The model treatment system is depicted in Figure XIII-1 and PSES and PSNS are shown in Table XIII-1.

TABLE XIII-1

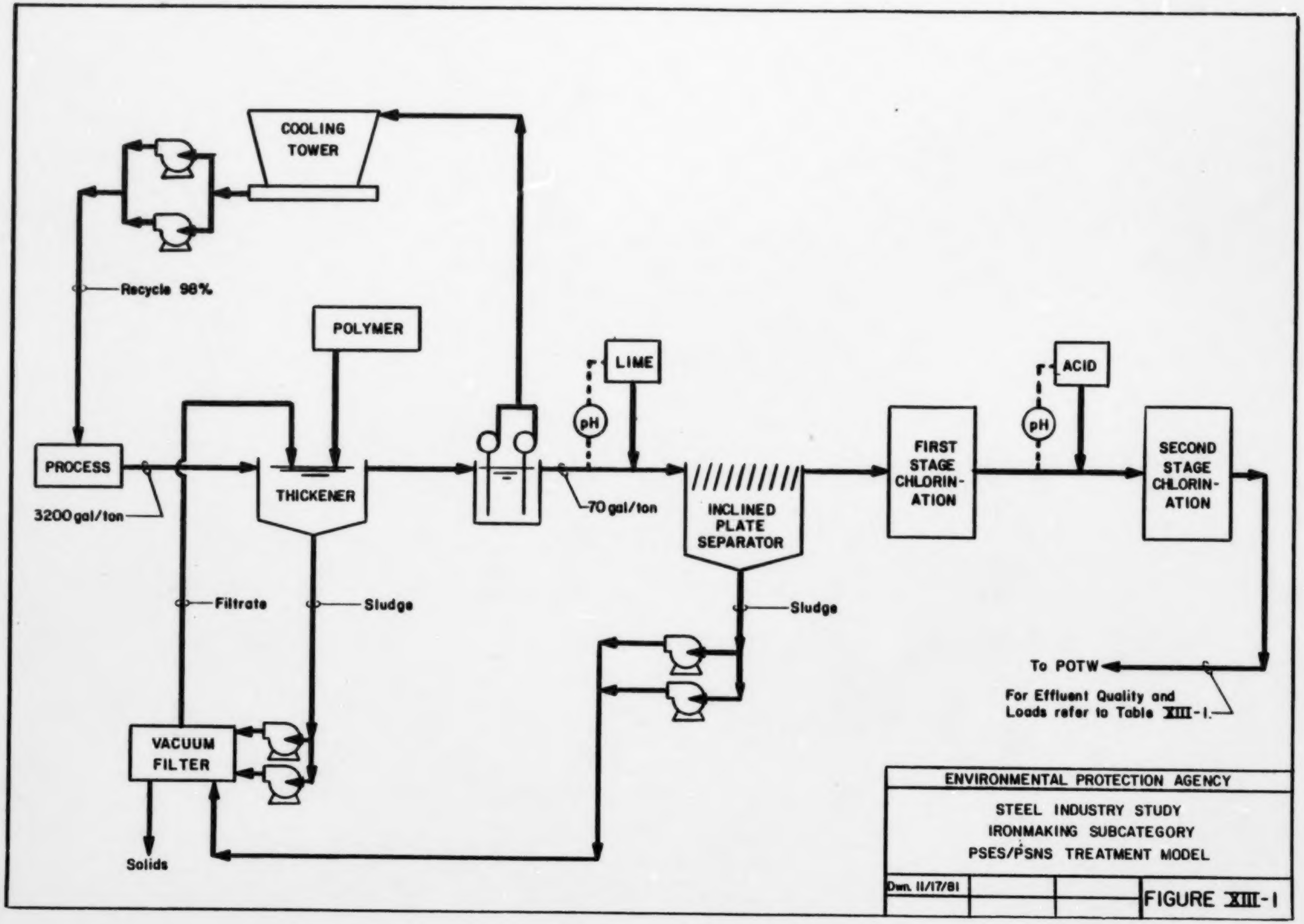
ALTERNATIVE PSES AND PSNS
IRONMAKING SUBCATEGORY

	Alternative No. 1		Alternative No. 2		Alternative No. 3		Alternative No. 4		Alternative No. 5		Alternative No. 6		Alternative No. 7	
	kg/kkg[1]	mg/l	kg/kkg[1]	mg/l	kg/kkg[1]	mg/l	kg/kkg[1]	mg/l	kg/kkg[1]	mg/l	kg/kkg[1]	mg/l	kg/kkg[1]	mg/l
Ammonia (as N)														
Average	0.0537	103	-[2]	-	0.0301	103	0.0301	103	0.00292	10	0.00292	10	-	-
Maximum	0.161	309	-	-	0.0902	309	0.0902	309	0.00876	30	0.00876	30	-	-
Cyanide (T)														
Average	0.00782	15	-	-	0.00146	5	0.00146	5	0.000292	1	0.000292	1	-	-
Maximum	0.0235	45	-	-	0.00292	10	0.00292	10	0.000584	2	0.000584	2	-	-
Phenols (4AAP)														
Average	0.00208	4	-	-	0.00117	4	0.00117	4	0.0000292	0.1	0.0000292	0.1	-	-
Maximum	0.00626	12	-	-	0.00234	8	0.00234	8	0.0000584	0.2	0.0000584	0.2	-	-
Lead														
Average	0.000261	0.5	-	-	0.0000730	0.25	0.0000730	0.25	0.0000730	0.25	0.0000730	0.25	-	-
Maximum	0.000782	1.5	-	-	0.000219	0.75	0.000219	0.75	0.000219	0.75	0.000219	0.75	-	-
Zinc														
Average	0.000365	0.7	-	-	0.0000876	0.3	0.0000876	0.3	0.0000876	0.3	0.0000876	0.3	-	-
Maximum	0.00110	2.1	-	-	0.000263	0.9	0.000263	0.9	0.000263	0.9	0.000263	0.9	-	-
Flow														
l/kkg	521		0		292		292		292		292		0	
gal/ton	125		0		70		70		70		70		0	

---

(1) kg/kkg (lb/1000 lb) of product
(2) Alternatives Nos. 2 and 7 accomplish no discharge of process wastewater pollutants.

Note: PSES and PSNS are based upon Alternative No. 5, the selected alternative.


COOLING TOWER
Recycle 98%
POLYMER
LIME
pH
ACID
pH
PROCESS
3200 gal/ton
THICKENER
70 gal/ton
INCLINED PLATE SEPARATOR
FIRST STAGE CHLORIN-ATION
SECOND STAGE CHLORIN-ATION
Filtrate
Sludge
Sludge
To POTW
For Effluent Quality and Loads refer to Table XIII-1.
VACUUM FILTER
Solids

ENVIRONMENTAL PROTECTION AGENCY

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IRONMAKING SUBCATEGORY
PSES/PSNS TREATMENT MODEL

Dwn. 11/17/81

FIGURE XIII-1

*U.S. GOVERNMENT PRINTING OFFICE: 1982-0-361-085/4452